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VOL. CXXXV.—No. 3498] LONDON: FRIDAY EVENING, JANUARY 12, 1923 [PRICE ONE SHILLING BY ISLAND POST 1s. 3d.

PUBLIC NOTICES

The High Commissioner for India is prepared to receive TENDERS for the SUPPLY of— RAILWAY CARRIAGES.

Forms of Tender may be obtained from the Director-General, India Store Department, Branch No. 15, Belvedere-road, Lambeth, S.E. 1, and Tenders are to be delivered at that Office not later than Two o'clock p.m. on Tuesday, the 20th February, 1923.

T. RYAN, Director-General.

1196

Works Manager REQUIRED by the GOVERNMENT OF NIGERIA for the Public Works Department, for two tours of from 12 to 18 months' service, with possible extension. Salary £720 a year for the first three years of service, and thereafter rising by annual increments of £40 to £920 a year. Duty allowance of £72 a year whilst performing the duties of the office in the Colony. Free single quarters and passages. Liberal leave in England on full salary.

Candidates, age not over 40, should have had charge of the Carriage and Wagon Shops of a British Railway, of the Shops of a firm of Carriage and Wagon Builders, or of a large Building Contractors. They should possess a considerable knowledge of Mechanical Engineering. They must be competent to Organise and Take Entire Control of large Sawmill, Carpentry, Joinery and Furniture Workshops, and Carpentry School, and generally supervise Stone-crushing Plant and Brick and Tile Works. Experienced foremen are in charge of these various shops and works.—Apply at once, in writing, giving brief outline of qualifications and experience, and stating age, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, S.W. 1, quoting M/11,601.

It is useless for candidates without the experience and qualifications specified to apply. 1195

METAL WORKERS.

THE WORSHIPFUL COMPANY OF ARMOURERS AND BRASIERS in conjunction with THE WORSHIPFUL COMPANY OF CARPENTERS.

TRADES TRAINING SCHOOL,

133, Great Titchfield-street, W. 1, near Great Portland-street Station, Metropolitan Railway.

PRACTICAL CLASSES FOR BRAZIERS AND SMITHS.

Open to those engaged in the trade.

BRASS AND COPPER WORK—Instructor: Mr. E. N. COLDWELL.

IRONWORK—Instructor: Mr. H. COLLINS.

CLASS NIGHTS—Ironwork: Tuesdays and Thursdays, 7 to 9.30.

Brass and Copper Work: Wednesdays and Fridays, 7 p.m. to 9.30 p.m.

FEES—Adults, 5s. per term; apprentices and improvers, 2s. per term.

Students can join the classes at any time.

Mid Term: December 4th, 1922, to February 16th, 1923.

End Term: February 19th, 1923, to May 4th, 1923.

SYDNEY PITT, Clerk.

Armourers' Hall, 81, Coleman-street, E.C. 2. 1160

University of London.

NOTICE IS HEREBY GIVEN that the SENATE WILL PROCEED to ELECT EXTERNAL EXAMINERS for the Examinations above Matriculation, as follows: Examiners are normally required to act in all Examinations in which the subject is included.

FOR THE CALENDAR YEAR 1923.

ENGINEERING, CIVIL and MECHANICAL (TWO).

METALLURGY and ASSAYING.

MINING and MINE SURVEYING.

N.B.—Attention is drawn to the provision of Statute 124, whereby the Senate is required, if practicable, to appoint at least one Examiner who is not a Teacher of the University.

Application (or forms if more than one Examinership is applied for) and particulars of the remuneration and duties, can be obtained from the External Registrar.

Candidates must send in their names to the External Registrar, Geo. F. Goodchild, M.A., B.Sc., with any attestation of their qualifications they may think desirable, on or before Monday, 22nd January, 1923. (Envelopes should be marked "Examinership.")

The Senate desire that no application of any kind be made to individual members.

If testimonials are submitted, one copy only of each is required. In no case should original testimonials be submitted. If more than one Examinership is applied for, a separate application, complete with copy of testimonial, must be forwarded in respect of each Examinership. The appointments in Engineering will probably be made by the Senate towards the end of February. Applicants who desire that the result should be communicated to them are requested to enclose a stamped and addressed envelope with their applications.

E. C. PERRY, Principal Officer.

University of London, South Kensington, S.W. 7. January, 1923. 1185

University of London. University College

The following ENTRANCE SCHOLARSHIPS, available for STUDENTS entering the FACULTY of ENGINEERING in October, 1923, each of the value of £40 a year, for three years, MAY BE AWARDED on the results of an Examination to be held in May, 1923:—

(1) THREE ANDREWS SCHOLARSHIPS.

(2) A GOLDSMID SCHOLARSHIP.

Full particulars may be obtained on application to the undersigned.

WALTER W. SETON, Secretary.

University College, London. (Gower-street, W.C. 1.) 1191

County Borough of St. Helens.

The Corporation of St. Helens are prepared to receive SCHEMES and TENDERS for the SUPPLY, DELIVERY and ERECTION of an ICE PLANT, 10 tons capacity.

Will firms desirous of submitting schemes communicate with the undersigned?

ARTHUR W. BRADLEY, M. Inst. C.E., Borough and Water Engineer.

Town Hall, St. Helens. January, 1923. 1234

The Engineer

PRINCIPAL CONTENTS OF THIS ISSUE.

Chinese Government Railways.

Dillingen Hutte Works, Saar Valley.

A Large Switchgear Works.

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Mechanical Stoking at Sea.

French Petrol Railcar.

Variable Speed A.C. Motors without Commutators.

PUBLIC NOTICES

Administrative County of LONDON.

The London County Council invites TENDERS for the SUPPLY and ERECTION of about 1300 Yards of 3ft. 6in. WROUGHT IRON UNCLIMBABLE FENCING and GATES at various Parks and Open Spaces. Specifications, plans and forms of Tender and contract can be had on application to the Chief Officer, Parks Department, The County Hall, Westminster Bridge, S.E. 1. Tenders must be delivered in the envelope provided to the Clerk of the Council at the County Hall not later than 4 p.m. on Monday, 29th January, 1923.

The Council does not bind itself to accept the lowest or any Tender.

JAMES BIRD, Clerk of the London County Council.

1200

Bengal-Nagpur Railway Company, LIMITED.

The Directors are prepared to receive TENDERS for—

GIRDER BRIDGES (80ft. and 40ft. Deck Spans).

Specification and form of Tender can be obtained at the Company's Offices, 132, Gresham House, Old Broad-street, London, E.C. 2, on or after 9th January, 1923.

A fee of £1 1s. will be charged for the specification, which is not returnable.

Tenders must be submitted not later than Noon on Friday, 19th January, 1923.

The Directors do not bind themselves to accept the lowest or any Tender.

By Order of the Board, E. C. VOLKERS, Secretary.

1204

Bombay, Baroda, and Central INDIA RAILWAY COMPANY.

The Directors are prepared to receive up to Noon on Friday, 26th January, TENDERS for the SUPPLY of PIG IRON.

Tenders must be made on forms, copies of which, with specification, can be obtained at these offices on payment of 10s. each (which will not be returned).

The Directors do not bind themselves to accept the lowest or any Tender.

S. G. S. YOUNG, Secretary.

Offices, 91, Petty France, Westminster, S.W. 1. 10.1.23. 1246

City of Nottingham.

TO HEATING AND HOT WATER ENGINEERS.

The Committee of Visitors of the Nottingham City Asylum invite TENDERS for the SUPPLY and ERECTION of HEATING, DOMESTIC HOT WATER SUPPLY and STEAM PLANT, including Alterations to Existing Plant at the City Asylum, Mapperley-hill, Nottingham.

Tenders must include for the whole of the work specified, and not sections only.

Plans may be seen and specification obtained on payment of Two Guineas (which will be returned on receipt of a bona fide Tender) from the Consulting Engineer, Mr. T. J. R. Kiernan, B.Sc., M. Inst. C.E., 17, Victoria-street, Westminster, S.W. 1, between the hours of 10 and 4 (Saturdays excepted), or from the City Engineer, Guildhall, Nottingham.

Sealed Tenders, endorsed "Heating, &c., Plant, Nottingham City Asylum," to be delivered to me not later than Monday, the 5th February next.

The Committee do not bind themselves to accept the lowest or any Tender.

By Order, W. J. BOARD, Town Clerk.

Guildhall, Nottingham. 9th January, 1923. 1210

PUBLIC NOTICES

East Indian Railway.

The Directors are prepared to receive up to Eleven o'clock a.m. on Wednesday, the 24th January, TENDERS for the SUPPLY of—

(1) WOOD SCREWS, NAILS, &c.

(2) WROUGHT IRON PIPING, &c.

Copies of the specifications can be obtained at the Company's Offices on payment of £1 1s. each. This fee will not be returned.

G. E. LILLIE, Secretary.

73-76, King William-street, London, E.C. 4. 10th January, 1923. 1227

Liverpool Corporation Water-WORKS.

VYRNWY SUPPLY.

NEW FILTER BEDS, OSWESTRY.

The Water Committee of the Liverpool Corporation are prepared to receive TENDERS for the CONSTRUCTION and satisfactory COMPLETION of THREE FILTER BEDS and other ancillary WORKS, situated at Oswestry, in the County of Salop.

The plans may be inspected and copies of the specification and forms of Tender obtained at the Water Engineer's Office, Alexandra Buildings, 55, Dale-street, Liverpool, upon payment of the sum of Five Guineas, which amount will be returned upon receipt of a bona fide Tender.

Tenders, endorsed "Tender for Filter Beds," are to be sent through the post, in a sealed envelope, to the Town Clerk's Office, Municipal Buildings, Liverpool, addressed to the Chairman of the Water Committee, so as to be delivered not later than Twelve o'clock Noon on Tuesday, 23rd January, 1923.

The Water Committee do not bind themselves to accept the lowest or any other Tender.

WALTER MOON, Town Clerk.

Municipal Buildings, Liverpool. 3rd January, 1923. 1148

Metropolitan Water Board.

TENDERS FOR THE MANUFACTURE, DELIVERY AND FIXING OF FIVE LANCASHIRE BOILERS, &c., AT THE SURBITON PUMPING STATION, SURREY.

The Metropolitan Water Board invite TENDERS for the MANUFACTURE, DELIVERY and FIXING of FIVE LANCASHIRE BOILERS, SUPERHEATERS, ECONOMISER, PIPING, FEED PUMPS, &c., at their Surbiton Pumping Station.

Forms of Tender, conditions of contract, specification and drawings may be inspected without payment of fee at the Offices of the Board, Chief Engineer's Department, Room 132, 173, Rosebery-avenue, Clerkenwell, E.C. 1, on and after Saturday, 13th January, 1923.

Contractors desirous of tendering may obtain the necessary documents from Mr. Henry E. Stilgoe, M. Inst. C.E., the Chief Engineer, on production of an official receipt for the sum of Three Guineas, which sum must be deposited with the Accountant to the Board, and will be refunded on receipt of a bona fide Tender, together with all incidental papers.

Such payments and applications must be made between the hours of 10 a.m. and 4.30 p.m. (Saturdays, 10 a.m. and 12 noon).

Cheques must be made payable to the "Metropolitan Water Board," and not to individuals.

Tenders, enclosed in sealed envelopes, addressed to "The Clerk of the Board, Metropolitan Water Board, 173, Rosebery-avenue, E.C. 1," and endorsed, "Tender for Boilers, Surbiton," must be delivered at the offices of the Board not later than 10 a.m. on Monday, 5th February, 1923.

The Board do not bind themselves to accept the lowest or any Tender.

G. F. STRINGER, Acting Clerk of the Board.

Offices of the Board, New River Head, 173, Rosebery-avenue, E.C. 1. 6th January, 1923. 1197

PUBLIC NOTICES

BRITISH EMPIRE EXHIBITION, 1924.

SHIPBUILDING, MARINE, MECHANICAL, AND GENERAL ENGINEERING SECTION

FIRST ALLOTMENT OF SPACE.

The FIRST ALLOTMENT of SPACE to intending exhibitors in the above Section will be made by The British Engineers' Association Exhibition Committee on

THURSDAY, FEBRUARY 1st, 1923.

APPLICATIONS FOR SPACE

to be considered at this meeting must be delivered at the Offices of

THE BRITISH ENGINEERS' ASSOCIATION (Incorporated)

not later than Saturday, January 27th, 1923.

Full particulars and forms of application can be obtained at the Offices of The British Engineers' Association.

D. A. BREMNER, Director.

32, Victoria-street, London, S.W. 1. 1207

Madras and Southern Mahratta RAILWAY COMPANY, LIMITED.

The Directors are prepared to receive TENDERS for—

12,160 Imperial Gallons VARNISHES (Black Japan, Gold Size, French Polish, &c.).

In accordance with the specification which may be seen at the offices of the Company. The charge for each specification is One Guinea, which will not be returned.

Tenders must be sent in addressed to the SECRETARY, not later than 2 p.m. on Tuesday, 30th January, 1923, and marked "Tender for Varnishes."

The Directors do not bind themselves to accept the lowest or any Tender.

Company's Offices, 25, Buckingham Palace-road, Westminster, S.W. 1 9th January, 1923. 1238

Parish of Lambeth.

BOARD OF GUARDIANS

The Guardians of the Poor of the Parish of Lambeth hereby invite TENDERS for the PROVISION and INSTALLATION of ELECTRIC LIGHT WIRING and FITTINGS at the Lambeth Hospital, Brook-street, Kennington, S.E.

Printed forms of Tender (which alone will be received), with conditions annexed, together with specification, may be obtained at this office on any day (except Saturday), between the hours of ten and five, upon payment of £2 in respect thereof, which will be returned to each person sending in a bona fide Tender. The drawings may be inspected at this office, and copies thereof may be obtained upon payment of the sum of 2s.

The Tenders, which must be sealed and superscribed in accordance with the instructions set forth on the form of Tender, must be sent to the undersigned, or placed in the box provided for their reception in the office of the Clerk to the Guardians by the tenderers, or their representatives, should they so desire, on or before Tuesday, the 6th February, and will be opened in the Board Room at Noon on the following day, when all persons tendering, or their authorised agents, should be in attendance.

The Guardians do not pledge themselves to accept the lowest or any Tender.

By Order, JAMES L. GOLDSPINK, Clerk to the Guardians.

Guardians' Board Room and Offices, Brook-street, Kennington-road, S.E. 11. 11th January, 1923. 1229

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PUBLIC NOTICES

Great Northern Railway (Ireland)

PERMANENT WAY MATERIALS.

The Directors are prepared to receive TENDERS for the SUPPLY of—

BULL-HEAD RAILS,
FLAT-BOTTOM RAILS, and
FISH-PLATES,

of British Standard Sections; also

CAST IRON CHAIRS and
FASTENINGS.

Specifications, drawings and forms of Tender can be obtained from the Secretary.

Tenders, made out on forms supplied by the Company, should be delivered, under sealed cover, endorsed "Tender for Rails, &c.," not later than 10 a.m., on Friday, 2nd February, 1923.

The Directors do not bind themselves to accept the lowest or any Tender.

J. B. STEPHENS,
Secretary.

Amiens-street Station, Dublin,
10th January, 1923. 1238

Sevenoaks Union.

GUARDIANS' INSTITUTION AT SUNDRIDGE, SEVENOAKS, KENT.

The Guardians of the Poor of the Sevenoaks Union invite TENDERS for the following items of PLANT:

ONE GAS-FIRED BOILER, with Feed Pump and Accessories, to Specification R.S.I. No. 11.
ONE SMALL GAS ENGINE, with Accessories, to Specification R.S.I. No. 12.
ONE SMALL WATER-SOFTENING PLANT, with Main Storage Tank, to Specification R.S.I. No. 13.

The work includes the Supply of the Plants and their Erection on site at Sundridge, Kent.

Copies of the Specification Nos. 11, 12 and 13 can be obtained from the undersigned at Bank Chambers, High-street, Sevenoaks, Kent, on payment of a deposit of One Guinea for each specification, which will be returned as soon as the contract is let, provided that the Tender submitted is bona fide and complete. A duplicate copy of Specification No. 11, 12 or 13 will be supplied to tenderers on a payment of Half a Guinea each, which amount will not be returnable.

Tenders, sealed and clearly endorsed on the outside, must be sent in complete with the accompanying drawings and particulars, to the undersigned on or before Noon on Tuesday, the 6th February, 1923.

The Guardians do not undertake to accept the lowest or any Tender.

By Order,
F. H. VIBERT,
Clerk.

Bank Chambers, Sevenoaks,
9th January, 1923. 1222

State Electricity Commission of Victoria.

TENDERS FOR PLANT.

TENDERS are hereby INVITED for the SUPPLY, DELIVERY, &c., of the following for Morwell Power Scheme.

Copies of Tender form and specification may be obtained or inspected upon application to—

Agent-General for Victoria,
Melbourne-place, Strand,
London, W.C. 2.

SPECIFICATION NO. 23/8.—TRANSFORMERS.

Charge 5s. for first two copies of Tender form, conditions of contract and specification complete. This charge will be returned on receipt of a bona fide Tender.

A third or any further copies may be obtained on payment of 2s. 6d. per copy, not return ble.

PRELIMINARY DEPOSIT.—A preliminary deposit of 1 per cent. of total Tender price is required to be lodged with Tender.

The Commission does not bind itself to accept the lowest Tender.

Tenders, on prescribed form, properly endorsed and addressed, must be delivered to the undersigned in Melbourne not later than Twelve Noon on the 31st March, 1923.

R. LIDDELOW,
1099 Secretary.

State Electricity Commission

OF VICTORIA.

TENDERS FOR PLANT.

TENDERS are hereby INVITED for the SUPPLY, DELIVERY, &c., of the following for the Morwell Power Scheme.

Copies of Tender form and specification may be obtained or inspected upon application to—

Agent-General for Victoria,
Melbourne-place, Strand,
London, W.C. 2.

SPECIFICATION No. 23/7.—MOTORS, STARTERS, and ISOLATING SWITCHES.

CHARGE.—£2 2s. for the first two copies of Tender form, conditions of contract and specification complete. This charge will be returned on receipt of a bona fide Tender. A third, or any further copies, will be supplied for the sum of 10s. 6d. each, not returnable.

PRELIMINARY DEPOSIT.—A preliminary deposit of £40 is required to be lodged with Tender.

The Commission does not bind itself to accept the lowest or any Tender.

Tenders on prescribed form, properly endorsed, and addressed, must be delivered to the undersigned in Melbourne, not later than Noon on March 15th, 1923.

R. LIDDELOW,
Secretary,
State Electricity Commission of Victoria,
1206 Melbourne, Australia.

State Electricity Commission

OF VICTORIA.

TENDERS FOR PLANT.

TENDERS are hereby INVITED for the SUPPLY, DELIVERY, &c., of the following PLANT for the Morwell Power Scheme.

Copies of Tender form and specification may be inspected or obtained upon application to—

The Agent-General for Victoria,
Melbourne-place, Strand,
London, W.C. 2.

SPECIFICATION No. 23/9.—TRANSFORMERS and SPARES.

CHARGE.—10s. for first two copies of Tender form, specification and contract conditions complete. This charge will be returned on receipt of a bona fide Tender.

A third, or any further copies, may be obtained on payment of 5s. per copy, not returnable.

PRELIMINARY DEPOSIT.—A preliminary deposit of £10 is required to be lodged with Tender.

The Commission does not bind itself to accept the lowest or any Tender.

Tenders on prescribed form, properly endorsed, and addressed, must be delivered to the undersigned in Melbourne, not later than Noon on April 28th, 1923.

R. LIDDELOW,
Secretary,
State Electricity Commission of Victoria,
1206 Melbourne, Australia.

The Great Indian Peninsula Railway Company.

The Directors are prepared to receive TENDERS for the SUPPLY of the following STORES, namely:—

	Fee for Specification.
CARRIAGE UNDERFRAMES, with four-wheel Bogies	10s.

Specifications and forms of Tender may be obtained at this office on payment of the fee for the specification, which payment will not be returned.

The fee should accompany any application by post. Cheques and postal orders should be crossed and made payable to the Great Indian Peninsula Railway Company.

Tenders must be delivered in separate envelopes, sealed and addressed to the undersigned, marked "Tender for Underframes," or as the case may be, not later than Eleven o'clock a.m. on Tuesday, the 23rd January, 1923.

The Directors do not bind themselves to accept the lowest or any Tender.

R. H. WALPOLE,
Secretary.

Company's Offices,
41, Cornhill-avenue, E.C. 2, London,
10th January, 1923. 12 8

PUBLIC NOTICES

The South Indian Railway COMPANY, Limited,

are prepared to receive TENDERS for the SUPPLY of—

STRUCTURAL STEELWORK.

Specifications and forms of Tender will be available at the Company's Office, 91, Petty France, Westminster, S.W. 1.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked:—"Tenders for Structural Steelwork," must be left with the undersigned not later than Twelve Noon on Tuesday, the 30th January, 1923.

The Directors do not bind themselves to accept the lowest or any Tender.

A charge, which will not be returned, will be made of 10s. for each copy of the specifications.

Copies of the drawings may be obtained at the offices of Messrs. Robert White and Partners, Consulting Engineers to the Company, 8, Victoria-street, Westminster, S.W. 1.

A. MUIRHEAD,
Managing Director.

91, Petty France, S.W. 1,
5th January, 1923. 1190

Halifax Corporation Electricity DEPARTMENT.

APPLICATIONS are INVITED for the POSITION of BOILER-HOUSE SUPERINTENDENT. Candidates must have thorough experience of large modern Water-tube Boilers, Mechanical Stokers, and their economical operation. They must also be acquainted with the necessary Measuring Instruments in connection therewith and have a sound theoretical knowledge of the Chemistry of Combustion.

The salary will be at the rate of £400 per annum.

Applications, stating age, details of training, qualifications and general experience, together with copies of at least three recent testimonials, should be received by the undersigned at 29, Northgate, Halifax, not later than Monday, 15th January, 1923.

(Signed) W. M. ROGERSON, M.I.E.E.,
Borough Electrical Engineer.

WMR/FHW, 29/12/22.
29, Northgate, Halifax. 1120

SITUATIONS OPEN

WANTED (Dublin), WORKS MANAGER for small factory employing 50 hands on Repair of Telephone and Telegraph Instruments, &c., also Manufacturing small lines of General Engineering Stores.—Apply by letter, stating salary required, age, nationality and qualifications, to Box No. F1491, Kenny's Irish Advertising Headquarters, 65, Middle Abbey-street, Dublin. F1291 A

WANTED, YOUNG MAN, Age not Exceeding 25 years, as ASSISTANT to the CHIEF ENGINEER in a large Rolling Stock Works in Yorkshire.

Only applicants who have had a thorough technical training, preferably at one of the Universities, will be considered. This is a first-class opening with excellent prospects for the right man.

Address, stating age, salary required, and experience, 1243, The Engineer Office. 1243 A

ENGINEER REPRESENTATIVE REQUIRED by important company for East and West Riding of Yorkshire and Lincolnshire. Only gentlemen of good standing, accustomed to dealing with contracts for large and small amounts, and possessing undoubted technical and commercial abilities considered. Remuneration offered is on commission basis. There is ample scope, and a lucrative income can be earned. —Apply, stating full particulars of qualifications, present engagements, age, &c., to DIRECTOR, c/o S. Davis and Co., 30/31, St. Swithin's-lane, London, E.C. 1169 A

MANAGER REQUIRED for Firm on Tyneside, manufacturing Scientific Instruments used in connection with Power Plants; one having had experience with Distance Thermometers preferred. State age, qualifications and remuneration expected.—Address, P6677, The Engineer Office. P6677 A

MOTOR ENGINEERING WORKS MANAGER, capable of efficient supervision and of acquiring maximum production on repetition work. State age, salary required, when at liberty and full particulars of previous experience. Every application will be dealt with in strict confidence.—Address, Box 64, Wheeler's Advertising Agency, Manchester. P6680 A

SALES ENGINEERS REQUIRED, One Senior, two Juniors; must have had Drawing-office experience; good prospects to real order getters. State education, experience, age and salary required.—Address, 1172, The Engineer Office. 1172 A

SALES MANAGER WANTED by North-East Firm manufacturing Colliery Plant, Engineering Castings, &c.—Address, stating age, experience and salary required, P6676, The Engineer Office. P6676 A

SUPERINTENDENT STEEL ERECTOR REQUIRED by Constructional Firm in Manchester to Take Complete Control of all Outside Erection; must be practical man. State fully experience, age and salary required.—Address, 1182, The Engineer Office. 1182 A

WANTED by Leading Firm in Lancashire, First-class SENIOR DRAUGHTSMAN to Take Charge of Slow-speed Steam Engine Section of Drawing-office; up-to-date experience in the Design of Drop Valve and Uniflow Engines essential.—Address, stating age, experience and salary required, 1189, The Engineer Office. 1189 A

WANTED for Engineering Firm in the Midlands, DRAUGHTSMAN, used to Power Station Layouts and Constructional Steelwork. State age, experience and salary required.—Address, 1231, The Engineer Office. 1231 A

WANTED in London District, First-class DRAUGHTSMAN, used to Small Electrical Apparatus, including Motors and Dynamos.—Address, stating age, experience and salary, 1184, The Engineer Office. 1184 A

A LARGE ENGINEERING COMPANY in the Midlands REQUIRE the SERVICES of a Competent DRAUGHTSMAN, preferably with experience in Light Structural and Gantry Work.—Address, stating age, experience and salary desired, 1215, The Engineer Office. 1215 A

AN Old-established Firm of Heating and Ventilating Engineers in Westminster REQUIRE the SERVICES of an ASSISTANT DRAUGHTSMAN.—Address, giving full particulars of experience, age and salary required, 1191, The Engineer Office. 1191 A

CAPABLE DRAUGHTSMAN REQUIRED IMMEDIATELY; must be experienced in Surface Condenser Work.—Write, giving full particulars of age, technical and shop training, experience, salary expected, and date when free, to CHIEF DRAUGHTSMAN, The English Electric Company, Ltd., Willans Works, Rugby. 1215 A

DRAUGHTSMAN REQUIRED, with Experience in Light Motor Car Engine Design.—Address, giving full particulars of experience, salary required, 1247, The Engineer Office. 1247 A

TRANSFORMER DRAUGHTSMAN.—APPLICATIONS are REQUESTED for the APPOINTMENT of TRANSFORMER DRAUGHTSMAN with well-known British Firm of Electrical Engineers.

Applicants must have had first-class experience in the design and manufacture of Large High-tension Transformers.

The position would be a permanency and offers ample scope to a suitable man. Applications will be treated with strict confidence.—Address, 1059, The Engineer Office, giving full particulars of experience. 1059 A

SITUATIONS OPEN (continued)

DRAUGHTSMAN WANTED by Firm of Hydraulic Engineers near Sheffield; must be accustomed to Waterworks Fittings, Estimating and Designing. Good opening for right man.—Address, with particulars of age, experience and salary required, enclosing copies of testimonials, 1216, The Engineer Office. 1216 A

DRAUGHTSMAN WANTED, Fully Experienced in Railway Companies' Carriage, Wagon and Steel Car Work.—Apply by letter only, stating age, salary, &c., to METROPOLITAN CAR-RIAGE COMPANY, Saltley, Birmingham. 1174 A

DRAUGHTSMAN WANTED, Must Have Thorough knowledge of Steam Crane Design; no others need apply. State experience, age and salary required and when at liberty.—Address, 1233, The Engineer Office. 1233 A

EXPERIENCED LEADING DRAUGHTSMAN REQUIRED as Section Leader for Steam Turbine Department; must have had first-rate experience in getting out details and plant arrangements; able to organise work and control men.—Write, stating age, experience and salary required, Box 1194, Bell's Advertising Offices, Fleet-street, E.C. 4. 1194 A

LEADING DRAUGHTSMAN REQUIRED, Fully experienced in all classes of Steel Structures, Bridges and Gas Holders.—Apply by letter, giving details of experience, age and salary required, to the CHIEF ENGINEER, The Horseley Bridge and Engineering Co., Ltd., Tipton, Staffs. P6664 A

SENIOR DRAUGHTSMAN for Large Firm of Electrical Manufacturers; must have first-class experience of Electrical Motors of varying sizes. State age, experience and salary required.—Address, 1178, The Engineer Office. 1178 A

SENIOR DRAUGHTSMAN WANTED, with Good experience in the Lay-out of Steam Turbine Plants, Details and Arrangements.—Write, stating age, experience and salary required, Box 1212, Bells' Advertising Offices, Fleet-street, E.C. 4. 1223 A

STRUCTURAL STEELWORK DRAUGHTSMAN REQUIRED (London District), accustomed to Estimating, Designing and Detailing Steel-frame Buildings and General Structural Work.—Address, stating age, experience and salary required, 1221, The Engineer Office. 1221 A

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For continuation of Small Advertisements see page 3.

Harbours and Waterways in 1922.

IN our review a year ago of engineering progress in connection with harbours, docks, and waterways, we pointed out that the general depression of trade, the financial situation, and the high cost of labour combined to restrict public works construction not only in this country but abroad. Although the cost of labour and materials has continued to fall during the year 1922, the depression in connection with the export trade of this country has prevented any material improvement in the amount of work in connection with harbour undertakings put in hand during the year. The number of Bills of which notices have been given for the coming session of Parliament is smaller than ever before in recent times, and is significant of the conditions prevailing. In the following survey we refer to some of the more important works in hand or completed during the year, and we note projects, some of which will be actually proceeded with in the near future, while others, no doubt, must be postponed until trade conditions materially improve.

The attempts on the part of the Government to encourage the execution of public works with a view to the relief of unemployment have not so far led to the initiation of many important harbour and dock schemes. The Trade Facilities Act Committee has, however, approved several projects, and some of these are already in hand.

The principal legislation of the year affecting dock and harbour authorities was the passing of the Oil in Navigable Waters Act, 1922, the provisions of which came into operation on January 1st, 1923. The main features of the Act will be familiar to our readers and need not be referred to in detail. The principal result of the Act, so far as harbour and dock authorities are concerned, is that barges or other craft for receiving and filtering oily water from ships in port or in dry dock will have to be provided. Much ingenuity is being directed to the provision of efficient and economical means of collecting, separating and disposing of oily refuse. In several ports, including London and Liverpool, barges have already been provided or are under construction.

We cannot pass from these brief general notes without reference to the death, early in the year, of Sir William Matthews, who for many years occupied a position of outstanding distinction among harbour engineers not only at home but in the Dominions and abroad.

THE UNITED KINGDOM.

Port of London.

A Bill, promoted jointly by the Port of London Authority and the Midland Railway, sanctioning the construction of a floating landing stage and other works at Tilbury received the Royal Assent in July. Work in connection with this scheme, which is expected to cost approximately £1,000,000, has not, however, been commenced, the present intention being to put it in hand during the coming spring.

The equipment of the King George V. Dock, which was opened in 1921, was continued during the year, additional cranes and warehouses having been brought into use. Other works carried out during the year included additions to the facilities for the discharge, sorting and storage of frozen meat, tobacco storage, and grain-handling appliances. Two large floating grain elevators are now under construction. The new offices of the Port of London Authority in Trinity-square, were opened by Mr. Lloyd George on October 17th, 1922.

The Mersey.

The Mersey Docks and Harbour Board during the year speeded up the construction of the new Gladstone Wet Dock scheme. The Board approved an important modification and extension of the original proposals which involves the construction of a river wall across the entrance to the existing Gladstone Graving Dock and its extension northwards towards the sea, where it will enclose an area of foreshore upon which ultimately will be constructed further extensions of the Gladstone Dock system. This modification entails the closing of the Gladstone Graving Dock for a period of about two years. On its reopening it will be entered direct from the Gladstone Wet Dock and not from the river channel as formerly. An extension of the Prince's Landing Stage is now being carried out, and a portion of the improved facilities for dealing with overseas passengers and their baggage is already in use. At the eastern end of the Board's estate good progress has been made with the works for the accommodation of the oil trade, and the Dingle Jetty has been completed.

Messrs. Lever Bros., of Port Sunlight, are seeking parliamentary powers for the construction of a dock and railways at Bromborough, on the south side of the river Mersey.

Bristol Channel Ports.

At the port of Swansea, Palmer's Shipbuilding and Iron Company, Limited, of Hebburn-on-Tyne, is constructing a large graving dock and ship-repairing and engineering yard. The dock will be entered from the King's Dock and have an entrance 75ft. in clear width. It will be the largest dry dock in the Bristol Channel with the exception of the Avonmouth Dock. At Port Talbot, wharves are in course of construction in connection with the steel works and the patent fuel trade, and the existing graving dock is being lengthened. At Cardiff the Great Western Railway Company is carrying out a programme of improvements mainly in connection with the mechanical equipment of the docks and the extension of coal shipping facilities.

North-East Coast Ports.

Work was begun during the year on the reconstruction and enlargement of several of the smaller dry docks on the river Tyne. The Tyne Improvement Commissioners are building a new dredger and additional steam hoppers. At Sunderland a contract was let for the construction of a new graving dock for Messrs. T. W. Greenwell and Co. The dock, when completed, will be the largest on the river Wear, with an entrance 75ft. wide. It will give accommodation to ships of 500ft. in length.

Southampton.

The Trafalgar Dry Dock at Southampton is too small to accommodate the Majestic, the only dry dock of sufficient size in this country being the Gladstone Dock, Liverpool. A combination, representing the London and South-Western Railway Company, which owns the Southampton docks, and certain shipping and shipbuilding interests, proposed in 1921 to acquire the large Hamburg floating dock surrendered by Germany on which the Majestic had been lifted prior to her departure from the Elbe, and to enlarge and adapt this dock for permanent use at Southampton. The negotiations with the Admiralty with this object in view terminated without result early in the year, and the railway company thereupon decided to construct a new floating dock capable of lifting 60,000 tons. The dock will be 960ft. in length, and have a clear width of 134ft. It is now under construction by Sir W. G. Armstrong, Whitworth and Co., Limited, at Newcastle-upon-Tyne, and is expected to be completed by the summer. We published a description of the dock in our issue of October 20th, 1922. The railway company has also recently announced its intention of carrying out an ambitious programme of dock extension at Southampton. In the meantime the Southampton Harbour Board has in hand the deepening of Southampton Water, which it is carrying out with the assistance of the railway company in order to provide the increased depth required for the Transatlantic liners now using the port. The Trafalgar Dry Dock, which was enlarged in 1912, to accommodate the Olympic, was further increased in length in the autumn of last year by the addition of 15ft., making its total internal length 912ft. This extension was rendered necessary for the accommodation of the Berengaria which, before the enlargement, left barely a foot of clearance between the inner end wall and the caisson face.

Humber Ports.

In the course of the year an interesting experiment was carried out at Immingham in connection with the proposal to use that port as a terminal for a train ferry service between the Humber and a Swedish port. The train ferry boats which ran from Richborough and Southampton to France during the latter part of the war were sent to Immingham to embark a large number of Pullman cars which had been constructed in this country for continental service. They were taken direct to Calais and there discharged at the train ferry terminal.

The Great Central Railway Company continued during the year the reconstruction of the Grimsby Fish Market, and a large amount of reinforced concrete work was done in connection with the improvement of the company's works at that port. The company also let a contract for the strengthening and partial reconstruction of the viaduct and pier at New Holland, which is used in connection with the ferry service to Hull.

Workington.

A contract was let by the United Steel Company of Sheffield for the enlargement of the Workington Dock. The plans include the lengthening of the wet dock from 600ft. to 1000ft., and its widening from 350ft. to 450ft. The entrance will be enlarged to give a width of 70ft. in the clear with 30ft. over the sill at high water. The expenditure, which is estimated to be about £500,000, has been guaranteed by the Treasury under the Trade Facilities Act. These works, when completed, will enable the port of Workington to be used by steamers up to 10,000 tons deadweight capacity.

Holyhead.

The deepening of the inner harbour at Holyhead which the London and North-Western Railway Company began in 1921, proceeded during the year and made good progress. The bulk of the material to be removed from the harbour consists of rock, and a depth of about 16ft. is to be provided alongside the steam boat quays. As soon as this work is completed the mail steamers will use the quays in the inner harbour instead of the old Admiralty Pier as heretofore.

Manchester.

The Manchester Ship Canal Company acquired a lease of the property of the Shropshire Union Canal Company at Ellesmere Port, near the entrance of the Ship Canal. During the year the company put into service the new oil dock at Stanlow, near Ellesmere Port. The construction of this dock has made it possible for imports of low flash petroleum products to be dealt with on the canal. A new reinforced concrete wharf is now being constructed at Trafford Park, and additional warehouse accommodation of 53,000 cubic yards capacity has been completed at the Manchester docks. The construction of two large transit sheds and grain subways is in hand.

Scottish Ports.

The Clyde Trustees brought into use during the year a new installation of pneumatic grain elevators at the Meadowside Granary. The trustees were also busily engaged in connection with the strengthening and underpinning of a number of quay walls on the Clyde, work which was rendered necessary by the progressive deepening of the river channel. Portions of several quays have, in recent years, shown signs of serious failure. The quays now being reconstructed are the Anderston Quay on the north side of the river and Plantation Quay and Mavisbank Quay on the south side. The old west harbour at Greenock was filled up in connection with the extension of Harland and Wolfe's shipyard. This harbour is one of the oldest works of its kind in Scotland and was constructed in 1710.

The report of the Geddes "Axe" Committee, which was issued in February, called attention to the Peterhead National Harbour works, and suggested a reconsideration of the present plans, which involve the expenditure of between £600,000 and £700,000, to bring the work of construction to completion.

Irish Ports.

The Belfast Harbour Commissioners made a commencement with the carrying out of a portion of the scheme for which they obtained parliamentary powers in 1918, at a cost then estimated at £2,000,000. The most important section of the work already begun is the provision of new wharves for the oil industry with the necessary storage facilities. The Dublin Port and Docks Board began the construction of a new wharf in the Alexandra Basin, which will have, when completed, a depth of 46ft. alongside it at high water. Reinforced concrete caissons are being used in the construction of this work. The naval dockyard at Haulbowline, in Cork Harbour, was transferred from the Admiralty to the Free State Government.

Other Ports.

At Fowey, the Great Western Railway Company is busily engaged in improving the accommodation for ocean-going steamers engaged in the china clay traffic, and elaborate mechanical appliances for loading the clay are being installed. The deepening of the harbour is also in hand. The Great Eastern Railway Company continued the reconstruction of the old timber quay in Lowestoft harbour, which is piece by piece being replaced by a reinforced concrete structure which will enable the deepening of the berths alongside the quay to be carried out.

In the course of the year a Treasury guarantee was given to Messrs. Harland and Wolff, on the recommendation of the Trade Facilities Act Committee, in connection with the establishment of ship-repairing works on the river Thames, and improvements at the firm's Clyde shipyards. The expenditure involved is approximately £1,500,000. The work at the Clyde yards involves a good deal of new wharf construction and the enlargement of a dry dock.

Inland Waterways.

The Nottingham Corporation made good progress with the Trent improvement works between Nottingham and Newark, which will enable 120-ton barges to proceed from the sea up to Nottingham at all seasons of the year. The work involves the construction of four new locks between Nottingham and Newark, and a portion of the cost is being met by the Unemployment Grants Committee. The Lea Conservators began improvement works on the Lea Navigation between Enfield Lock and Hertford. Nine of the locks on this section of the waterway are to be reconstructed, the opportunity being taken to increase the width of those locks which are less than 16ft. at present. On completion of this work and the dredging of the navigation, barges of 100 tons capacity will be able to proceed up to Hertford.

Facilities for Oil Trade.

As in the year 1921, the provision of facilities for the accommodation of sea-borne oil traffic

was an outstanding feature of the works carried out in the larger ports all over the world. We have already referred to the Oil in Navigable Waters Act, 1921, and to the new oil dock constructed by the Manchester Ship Canal, which was opened in July. This dock, which is about 4½ miles from Eastham Locks, where the canal joins the river Mersey, is 600ft. long and 100ft. wide, with a depth of 30ft. The feature of the dock is the provision of a fire-proof floating cofferdam, which is placed across the entrance to the dock at all times when it is occupied by a ship. Elaborate provisions are made for dealing with the discharge of oil and petroleum spirit to the storage tanks of the oil companies. On the Tyne the Commissioners' new oil fuel berths at Jarrow were completed in July last. Leith has made provision for oil bunkering, and has provided a fleet of large oil storage barges for this purpose. The River Wear Commissioners have made provision at the South Dock, Sunderland, for oil bunkering, and have provided a special berth and wharf in connection with the various oil companies' storage tanks. The new refinery of the Anglo-Persian Oil Company at Llandarcey, near Swansea, was opened by the President of the Board of Trade on June 29th. It is the largest establishment of its kind in the United Kingdom, and it is stated that some three million sterling have been expended upon it. The refinery is connected by an elaborate system of pipe lines with the company's wharves and berths in the Swansea docks and harbour. As a result of the Anglo-Persian Company's activities at Swansea, the port has become one of the principal oil import and export centres of the United Kingdom. Messrs. Cory Bros., of Cardiff, have begun the installation of oil bunkering facilities in connection with their various coaling depôts on the chief shipping routes. The company has placed orders for a great number of oil storage tanks of large capacity which will be distributed among their depôts at home and abroad. Further developments in connection with oil storage and bunkering on Southampton Water took place during the year, including the provision of large storage tanks by the Agwi Petroleum Company at Fawley. At Grangemouth, Scottish Oils, Limited, is about to construct a bunkering jetty and oil storage plant. Similar developments are taking place at many Dominion and foreign ports.

BRITISH DOMINIONS AND INDIA

Canada.

The principal feature of development work in the Canadian ports during the past year was the extension of grain-handling facilities. Not only were the storage and handling appliances of the Montreal Harbour Commissioners largely extended, but Vancouver was busily engaged in providing up-to-date facilities. The electrification of the Montreal Harbour railways is now being carried out, and important extensions of quayage are in hand. At Vancouver work on the large dry dock was suspended, as was the construction of the Victoria Dry Dock. It is expected, however, that work will be resumed on the latter in the near future. The construction of the Ballantyne Pier at Vancouver is in hand, and is expected to be completed in the summer of 1923. Tenders were invited for the construction of the large locks on the Welland Canal. Up to the present less than half of the total work in connection with the construction of the canal has been completed. Early in the year the scheme for the proposed St. Lawrence deep waterway was investigated by a joint commission representing the United States and Canadian Governments; but it was subsequently officially announced that the Canadian Government did not regard the present moment as an opportune one for proceeding further with the project.

Australia and New Zealand.

In Australia much attention is also being given to the improvement of grain storage and handling appliances, and at all the principal wheat ports works are in hand, or proposed for immediate execution, with this object in view. The equipment for shipping coal in the New South Wales ports is likewise receiving attention. Harbour improvements are in hand at Melbourne, and a programme of works has been approved which will involve an expenditure of £1,500,000 in the near future. The works include the widening of the river Yarra near the city wharves and the construction of new docks. The Harbour Trust has nearly completed the deepening of the main Port Phillip channel to a depth of 34ft. at low water. Work was continued on the improvement of the river Murray Navigation upon which the Government is reported to have decided to spend some £8,000,000.

India.

The Calcutta Port Trust is still engaged on the King George Docks scheme, and at Bombay the Back Bay reclamation made good progress during the year. The Committee appointed by the Government of India to consider the schemes for the extension and improvement of Tuticorin Harbour reported in favour of the project, and improvement works are in hand at Cochin. The Rangoon Port Trust during the year proceeded with the investigation of the Dawbon Dock site where borings and other preparatory work are still in progress.

South Africa.

The construction of the new outer harbour works at Port Elizabeth was begun, the first concrete block of the breakwater having been laid during the year. The harbour works are estimated to cost £1,500,000, and the sheltered water area will be about 800 acres. The large new graving dock at Durban, which is being constructed by the Union Government, is well in hand. The contract for the entrance caissons has been secured by Sir W. G. Armstrong, Whitworth and Co. The entrances are 110ft. wide in the clear. Proposals for the improvement of Walfish Bay on the coast of South-West Africa are stated to be under consideration by the South African Government.

East Africa.

Work is still in progress at Kilindini Harbour in Kenya Colony, in spite of much local criticism of the Government proposals. The opening of the Trans-Zambesia Railway early in the year will increase the importance of the port of Beira, opening up, as it does, a vast extent of hinterland which can be served from that port. The great cyclone which devastated Chinde on February 24th has accentuated the decline in its activities, which was inevitable on the opening of the Trans-Zambesi Railway. Chinde, at the mouth of the Zambesi, has hitherto been the port through which most of the traffic with Nyasaland has passed.

West Africa.

The Takoradi Harbour works on the Gold Coast are now well in hand. Here, again, the Government plans come in for much criticism by local interests, particularly those interested in the neighbouring port of Sekondi. The improvement works at Lagos Harbour made good progress during the year, and the construction of wharfage at Port Harcourt, another Nigerian Harbour, has been commenced.

Malaya.

The wharf works at Prai, opposite Penang, are still in progress, but other work at the port has been cut down by the necessity of reducing expenditure. The construction of the causeway across the Johore Straits, between Singapore and the mainland, is in hand, and the navigation lock at the Johore end of the work is practically completed.

FOREIGN PORTS.

France.

There has been much discussion in France as to the works of public utility which the Government proposes that Germany should be required to execute in France under the terms of the Treaty of Versailles. The proposals ultimately adopted by the Government, include several important schemes for the improvement of inland navigation, but what the outcome of these proposals may be it is impossible to forecast. Many other schemes for harbour and navigation improvement in France are under discussion, including developments at Cherbourg, the improvement of navigation between Paris and the sea, and the canalisation of the Rhone. The most important works actually in hand at the moment are those in connection with the Marseilles-Rhone Canal and the extension of the Marseilles dock system. Good progress was made with these large works during the year. The French Government is also spending large sums on the improvement of ports in the French colonies of Northern Africa, including Casablanca and Dakar.

Germany and the Rhine.

None of the schemes for the improvement of the Rhine and navigations in connection with that river, which have been subject to much discussion and negotiation during the past four years, has yet been realised. The latest information available indicates that there is little prospect of Germany proceeding in the near future with the construction of any of the huge canal and river improvements which have been proposed. At Hamburg extensions are in progress in connection with the harbour accommodation.

Belgium.

On November 12th the King of the Belgians inaugurated the port of Brussels, the works in connection with which were practically completed in the summer of 1914.

Italy.

A contract has been placed for the port extension works at Spezia. Port improvements are in hand at Venice, and the enlargement of the port of Leghorn is proposed. An interesting work was completed during the year at Trieste, when a 2000-ton reinforced concrete floating dock was launched at that port. We believe this dock, together with a somewhat similar floating dock constructed at Minden, in Germany, after the war, are the only examples of reinforced concrete construction applied to floating docks which are in existence. It is very unlikely that any more floating docks will be constructed of the same material. The Italian Government has in hand the improvement of the port of Naples, and proposals have been made for the construction, by private enterprise, of large shipping piers at that port.

Holland.

The widening and deepening of the waterway between the Hook of Holland and Rotterdam is making good progress. In connection with this work large areas of low-lying land are being reclaimed and raised in level by the deposit of the material dredged from the channel. The construction of the Meuse-Waal Canal, which will connect the river Waal and the canalised Meuse made good progress. Several of the locks have already been completed. The Dutch Government has decided, with a view to economy, to continue the work of the Zuyder Zee reclamation on a much smaller scale than had been originally intended. Preliminary work is in hand at Ymuiden on the enlargement of the North Sea-Amsterdam Canal and the new entrance lock.

Suez Canal.

The Western jetty at Port Said is being extended with the object of reducing the amount of dredging required in the entrance channel. At present the canal has a depth of 11 m. throughout practically the whole of its length, and operations are in progress for increasing the depth to 12 m. It is expected that ships drawing 33ft. will be able to make the passage of the canal in 1924. A scheme of further improvements has been sanctioned providing for vessels drawing 35ft. and the widening of the Northern section of the canal to 60 m.

China.

The report of the International Commission of Engineers, which, during the latter months of 1921 investigated schemes for the improvement of the port of Shanghai, was issued early in the year. The Commissioners recommend the reconstitution of the Harbour Authority, the provision of powerful dredgers and the execution of an extensive dredging programme on the Yangtze Bar, together with the provision of additional wharfage and dock accommodation. The expenditure on immediate requirements is estimated at over £2,000,000. Much attention is being directed to the improvement of the Yangtze River, which is at present the subject of expert investigation.

United States.

There is considerable activity, both in the Atlantic and Pacific ports of the United States, in connection with the construction of steamship piers and berths of large dimensions. At New York and Philadelphia much work of this description is in hand, many of the new piers being 1000ft. or more in length. The Inter-State Commissioners for the port of New York made public, early in the year, their scheme for the future development of the port works and railway terminals. This scheme, in the main, follows the lines of the plans laid before them in 1921. The principal work under construction at the present time in New York harbour is the Lehigh Valley Railway Company's marine terminal at Jersey City, to which we referred in our last Annual Review.

Japan and Manchuria.

The first section of the Kobe Harbour extensions begun in 1907 was completed in May. Large schemes of port development are in hand at Yokohama, Shimonoseki, Shimidzu, and Hokkaido, as well as at Kobe. In Manchuria the Japanese are carrying out wharf construction at Dairen, and the Chinese Government proposes to develop the harbour of Hulutao.

South America.

A new contract has been made for the completion of the Buenos Ayres Harbour works, the construction of which was interrupted during the war. The Chilean Government is about to put in hand extensions of the Valparaiso Port works, the first section of which was recently completed by Messrs. S. Pearson and Son, Limited. Harbour improvements are also in hand or about to be started at Antofagasta and other Chilean ports.

THE port authorities at Leixoes, two miles from, and the sea port for, Oporto, and three miles from the mouth of the river Duro, have decided to construct a dock known as "Noil," together with a canal leading to it. Foreign tenders for the work are invited. It is stated that there are 30,000,000 escudos available for the work, the present value of the escudo being 2.3/16d. to 2.5/16d., against a par value of 53½d. All correspondence should be addressed to the Junta Autonoma das Instalacioes Maritimas do Porto, Porto, Portugal.

Dillingen Hutte Works—Saar Valley

THE industrial area lying along the river Saar, including the towns of Saarbrucken and Saarlouis, and stretching north for some miles, has been of great interest politically in recent years. It was one of Germany's principal coal mining areas, and contained many industrial establishments. Its position, close to the French frontier, made it liable to air raid, and, in fact, during the war it was repeatedly raided by our Allies. As compensation for the destruction of the French coal mines in Northern France, the mines in this area were ceded to France, and the Saar Valley itself was taken out of the German kingdom and given a separate administration. Article 49 of the Versailles Treaty enacts that this area is to be controlled by a Governing Commission appointed by the League of Nations. On this body Germany may not have a representative. At the expiration of fifteen years a plebiscite is to be held of the inhabitants to decide what the future form of Government shall be. At present the area is occupied by French troops, like the occupied districts on the Rhine.

The Saar Valley is divided into two main districts. The densely-populated area round the coal mines at Saarbrucken and the surrounding neighbourhood, which in many characteristics resembles the Ruhr Valley and some parts of Silesia. North of this is a more rural area, and in this area lies Dillingen. This village on the Saar is on the railway joining Saarbrucken to Tréves, and the steel works situated there are of considerable interest. The Dillingen Hutte Works have been in existence many years, but have been extensively rebuilt and modernised. The main reason for the recent expansions was the fact that this steel company was the only one in Germany, in addition to Krupps at Essen, which could make armour plate. The orders were fairly evenly divided between the two firms, and each expanded its plant considerably to meet the increased demands for armour plate, consequent upon the passing of the 1906 Navy Bill.

Dillingen and Essen collaborated very closely in the manufacture of armour plate. The Krupp process was in use at both works. Dillingen claimed to be able to manufacture 12,000 tons of finished armour plate per year, although it is understood that this output was never realised. The plates from Essen and Dillingen were subject to the same tests before acceptance, and all firing trials were carried out at Meppen Range or at Essen by Messrs. Krupps.

It has already been stated that French troops are in occupation of this area, and French capital is now largely interested in these steel works. Of course, the manufacture of armour plate has stopped, but the demand for steel of all kinds for structural purposes, railway work, shipbuilding, &c., is quite brisk, and the firm is actively employing the whole of its 7000 employees in the manufacture of purely commercial iron and steel products. The steel works lie on the edge of the village, and the surroundings are comparatively pleasant, there being no adjacent works of large size and consequently there is plenty of room for expansion.

The road leading to the main entrance is bordered by large houses surrounded by gardens. These serve as hospitals, convalescent homes, &c., for the employees, and are run as an integral part of the firm's activities. As is usual with big German firms, a special feature is made of this welfare work, the employers contributing largely to the upkeep of the various medical and other agencies, which are run for the benefit of their employees. These buildings and the surroundings generally at Dillingen give a pleasanter appearance than one usually associates with a steel foundry.

The ore used at Dillingen comes from Lorraine and the coal is mined in the Saarbrucken district.

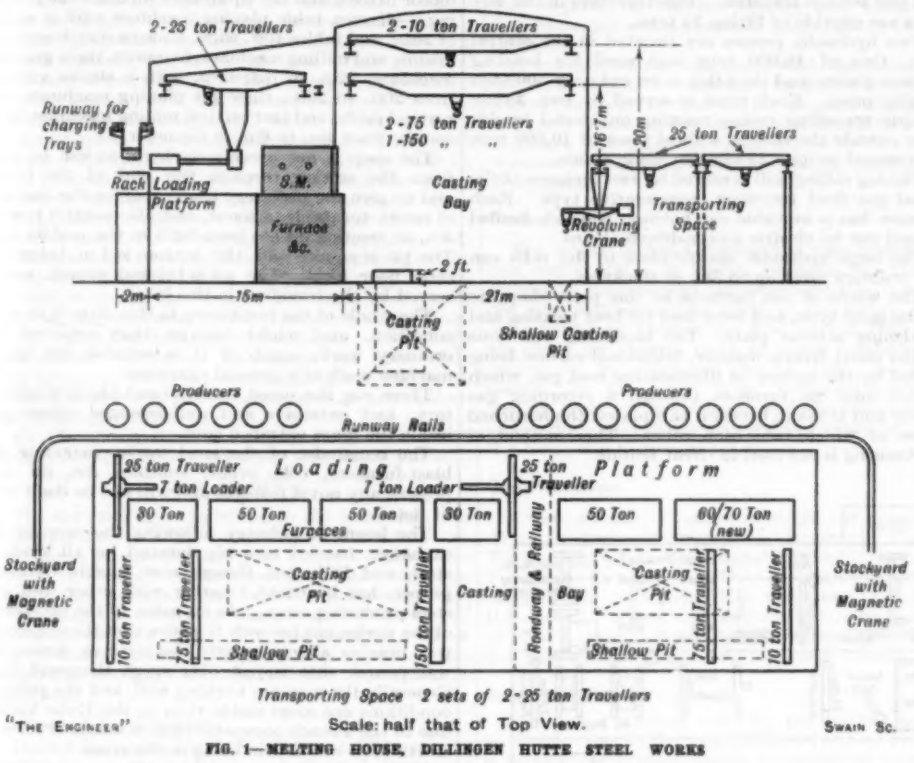


FIG. 1—MELTING HOUSE, DILLINGEN HUTTE STEEL WORKS

STEEL WORKS.

There are four blast-furnaces and four coke ovens. Two of each are continuously in use, and about 11,000 tons of Thomas pig iron are produced monthly. During the war the maximum output was 15,000 tons per month, but the shifts have now been reduced from ten to eight hours. Crucible steel is not made at Dillingen, but ordinary steel forgings were turned out in large quantities and sent to various shell shops in Germany for machining.

Although armour plate is not now manufactured, it is hoped that an increasing amount of the special plant laid down will be convertible for use in ordinary commercial production.

Among the recent buildings one of the most interesting is the new melting house, which was built in 1911 to replace an older shop near the main offices. The general arrangement of this new shop is shown in Fig. 1, which also gives the capacities, &c., of the furnaces and travellers, and shows the arrangement of the stock yards, melting pits, gas producers, &c.

There are six Siemens-Martin furnaces, two of 30 tons, three of 50 tons, and a bigger furnace with a capacity of over 60 tons, which has only recently been completed. These furnaces are basic lined, and are heated by gas supplied from producers situated along one side of the shop. The producers are of the following types:—six Rehmann, six Erhardt, and Sehmer, and four of a new type of Siemens only recently installed. One furnace has Maerz ports, one gas and two air ports at each end. the central gas ports being inclined at about 12 deg. Experiments were made using coke oven gas supplied direct to one furnace to supplement the producer gas. The high temperatures resulting soon destroyed the furnace roof, and the coke oven gas is now mixed with the producer gas in the mains before reaching the furnaces.

The furnaces are arranged as indicated in Fig. 1, and the overall dimensions of a 30-ton furnace are approximately 35ft. long and 17ft. wide. The bath is 28in. wide at the tapping hole. The 50-ton furnaces are 45ft. long with the same cross section.

There is a stock yard at each end of the melting house. An overhead runway connects these yards with the charging platform, as shown in Fig. 1. A 5-ton electro magnetic crane is provided in each stock yard to deal with the scrap and load the charging boxes. The latter each hold from 3–3½ tons, and the grab crane which runs on the overhead railway can take three of these boxes at once. The charge is usually made of scrap with Thomas pig iron. The overhead charging machines on the platform can lift 7 tons, and with much of the crane equipment were made by the well-known firm D. E. M. A. G., of Duisburg. The gas producers being outside the runway do not interfere with the charging of the furnaces.

A heat of mild steel is obtained in from six to eight hours when using a mixture of coke oven and producer gas and some two hours longer if only producer gas is used. For mild steel about twelve heats can be obtained per week from each furnace in use.

Covering the casting pit there are two sets of travellers on different levels. The lower rails are 16.7 metres above floor level, and carry two travellers lifting 75 tons and one lifting 150 tons, each traveller

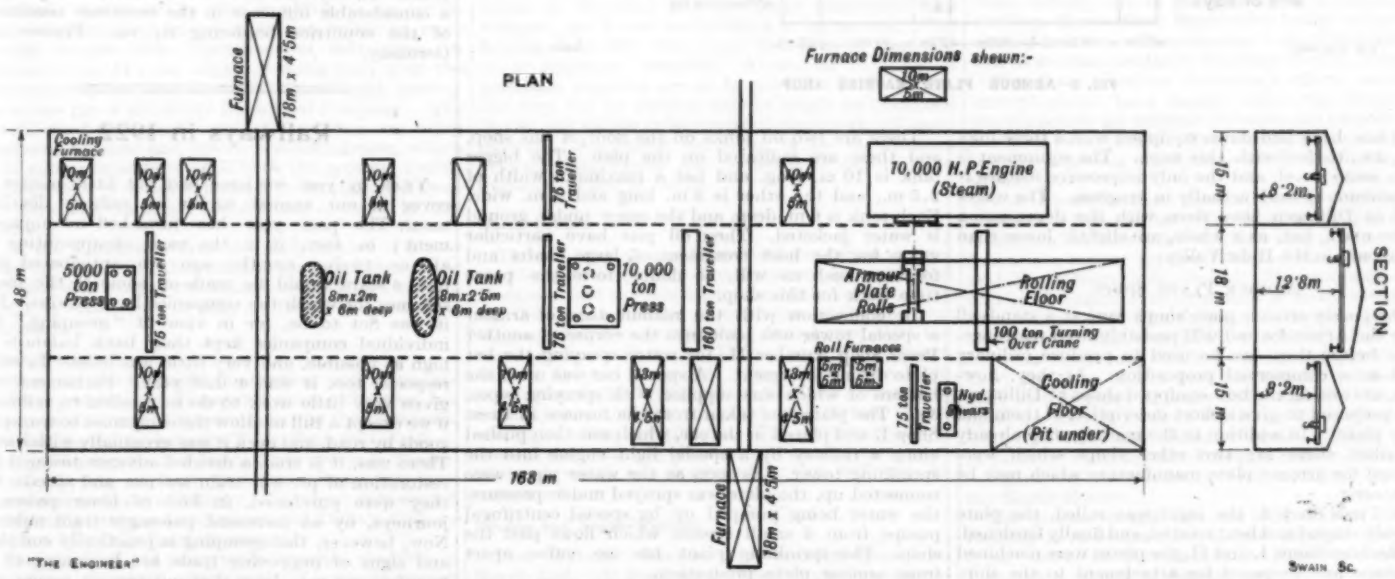


FIG. 2—ARMOUR PLATE ROLLING AND PRESSING SHOP

having a light lift hook to take 25 tons. Above these are two 10-ton travellers running on rails 20 m. above the floor.

The ingot mould pits are also indicated on the sketch plan. The deep pits in the middle of the shop are capable of taking two of the largest sized ingots which were used for armour plates. The largest ingot cast was about 80 tons, and the biggest bucket used held 60 tons of metal.

In addition to the large casting pits a long shallow pit is arranged parallel to the face of the furnaces along the side of the shop. The two pieces together measure about 100ft. in length, and are each about 14ft. deep. The ordinary small ingots are cast in these pits, and the 10-ton travellers on the upper rails are used for stripping the moulds off these ingots.

Outside the shop, and parallel to the small pit, is a transporting space, which is used for the stowage of ingots and ingot moulds, &c. Two sets of travellers serve this area and run on elevated rails supported by uprights. The inner 25-ton travellers carry revolving jib cranes, the jibs of which can project sufficiently far through open spaces in the shop wall to enable ingots and moulds to be lifted direct from the casting bay and taken into the transporting space.

The melting shop is a fine building, light, airy, and well equipped with travellers, &c. It can be taken as typical of recently built German steel foundries.

In addition to the usual furnaces there is a 10-ton electric furnace (Héroult), which was used during the war to obtain the higher grades of steel for special purposes. It has not been much in use since the end of the war, mainly owing to the cost of operation.

The works are at present occupied in the production of ordinary commercial steel, including rails, sleepers, plates and sections for shipbuilding, &c. A new

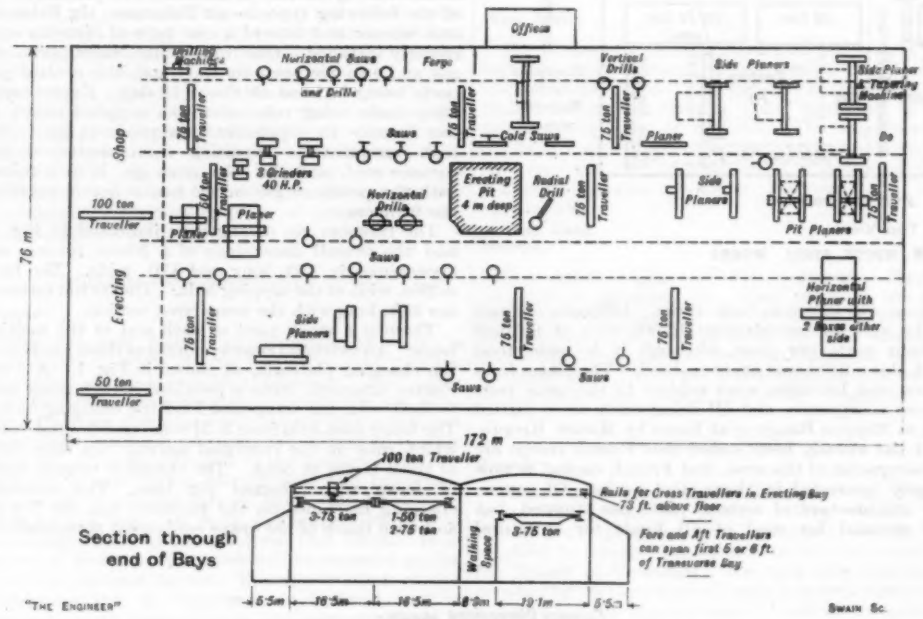


FIG. 3—ARMOUR PLATE MACHINE SHOP

shop has been laid down equipped with a three-high mill, &c., to deal with this work. The equipment is in no sense novel, and the only impressive feature is the amount of work actually in progress. The wages paid at Dillingen have risen with the depreciation of the mark, but, as a whole, are slightly lower than those paid in the Ruhr Valley.

ARMOUR PLATE SHOPS.

The purely armour plate shops were at a standstill after the Armistice and will probably need rearrangement before they can be used to produce ordinary steel as a commercial proposition. As they, however, are among the best equipped shops at Dillingen, it is proposed to give a short description of them and their plant. In addition to the melting shop already described there are two other shops which were utilised for armour plate manufacture which may be of interest.

In Press Shop I. the ingot was rolled, the plate roughly shaped and heat treated, and finally hardened. In Machine Shops I. and II. the plates were machined to shape and prepared for attachment to the ship. Machine Shop II. is the more modern, and details of its equipment will be given.

Press Shop I. is a comparatively old building dating from 1893. The dimensions and general arrangement are shown in Fig. 2, which also shows the position of the various furnaces, rolls, presses, &c. This is a typical layout for a heat treatment shop for armour plates made by the Krupp process. Although the building is old much of the plant is of recent date. The large rolling mills, specially designed for armour plate work, were made by Schneider at Le Creusôt. They are driven by a 10,000 horse-power steam engine of the 4-cylinder two-crank horizontal tandem type, built by Sach and Kresselbach, of Dusseldorf. The rolls are each 4.5 m. long, 1.25 m. in diameter, and weigh 52 tons. The rolling floor for this mill extends some 100ft. distant on one side to 40ft. away on the other side. A 100-ton turning-over crane is carried by a traveller which runs the full length of the live rolls. A large underground cooling pit is situated close to the rolls. These rolls are not efficient for the rolling of ordinary commercial rolled sections or thin plates, and will, it is understood, be replaced by more suitable rolls to enable the furnaces, &c., in this shop to be utilised.

There are three main bays, as indicated in Fig. 2. In the central bay there are two 75-ton travellers and one 160-ton traveller. The travellers in the side bays are capable of lifting 75 tons.

Two hydraulic presses are situated in the central bay. One of 10,000 tons was used for bending armour plates, and the other is an ordinary 5000-ton forging press. Each press is served by two 35-ton electric travelling cranes running on special tracks. Just outside the shop is a third press of 10,000 tons also served by two 35-ton travelling cranes.

The big rolling mill is served by two furnaces of the usual gas fired reversing, regenerative type. Each furnace has a movable car bottom, which is hauled in and out by electric motor-driven chains.

The large hydraulic shears close to the rolls can cut ordinary steel up to 3in. in thickness.

The whole of the furnaces in this press shop are of the same type, and were used for heat treating and hardening armour plate. The hardening was done in the usual Krupp manner, additional carbon being added by the agency of illuminating coal gas, which is led into the furnaces through a recording gas meter and is taken between two plates, the hardened faces of which face each other. This method of carburising is not used in Great Britain.

There are two oil tanks on the floor of this shop, and these are indicated on the plan. The bigger tank is 10 m. long, and has a maximum width of 2.5 m., and the other is 8 m. long and 2 m. wide. Each tank is 6 m. deep, and the space under ground is water jacketed. These oil pits have particular value for the heat treatment of large shafts and forgings, such as will, no doubt, form the peace time work for this shop.

In connection with the manufacture of armour a special tower was built into the corner of another Press Shop Number II. for water spraying the hot plate during treatment. A special car was used, the bottom of which was supplied with spraying pipes, &c. The plate was taken from the furnace in Press Shop I. and placed in the car, which was then pushed along a railway by a special light engine into the sprinkling tower. As soon as the water pipes were connected up, the plate was sprayed under pressure, the water being pumped up by special centrifugal pumps from a small stream which flows past the shop. This sprinkling plant has no value apart from armour plate production.

MACHINE SHOPS.

There are two machine shops at Dillingen which were used for the manufacture of armour plate. Machine Shop II. was only completed in 1908, and is interesting in that it may be taken as typical of an up-to-date machine shop for armour plate production by the Krupp process. It was built to meet the additional requirements for armour consequent upon the passing of the Navy Bill.

The general arrangement and overall dimensions of this shop are shown in Fig. 3.

There are three main longitudinal bays with a narrower walking space. These bays end in a transverse bay, which is sufficiently wide to enable erection of smaller shields, &c., to be carried out there. The rails carrying the travellers in this thwartships bay are higher than those in the longitudinal bays, and the latter are extended into the cross bay so that material can be easily transferred from one to another of the long bays. There are two travellers in the cross bay, one to lift 100 tons and one to lift 50 tons. The three travellers in each of the side long bays can each lift 75 tons. In the bay over the erecting pit there are three travellers, two of which can lift 75 tons, and one can lift 50 tons.

The machines in this shop are each separately motor driven, and the equipment includes the following:—Sixteen table planing machines with a stroke of 20ft., and tables 10ft. wide, some twenty horizontal drilling and milling machines, five saws, three grinding machines, 32in. in diameter, with a stroke varying from 20ft. to 25ft., three pit planing machines, two vertical drills, and two vertical milling machines, with spindle from 4in. to 6in. in diameter.

The shop is not excessively high, as can be seen from the section through the end of the bays; and to give the necessary head room for the erection of turret turntable armour, and also control towers, &c., an erecting pit has been built in the middle bay. The pit is square and the bottom is 4 m. below the shop floor level. The pit is bricked round, and is served by the travellers in this bay.

The whole of the machinery in this shop is in good condition, and whilst heavier than required for ordinary work, much of it is suitable for heavy machine work of a general character.

There are the usual chemical and physical laboratory, and extensive and well-arranged offices just inside the main entrance gate.

The remainder of the steel works, including the blast-furnaces, coke ovens, smithies, &c., do not present any novel features and will not be dealt with in detail.

The boom in industry following the drop in the exchange, has led to a big demand for all kinds of steel, and Dillingen, though now outside Germany proper, has benefited, together with other iron and steel-producing areas. As an index of the prosperity of the works, one has only to notice that the employees now number almost exactly the same as during the war period, that is, just over seven thousand men. Generally the men are working well, and the political conditions are more stable than in the Ruhr Valley, due to the French occupation and a modified form of martial law which is in being in the areas.

Dillingen has joined in the hunt for scrap material. The present demand for steel scrap has led to a boom in the shipbreaking industry, and a number of yards have been built solely for this purpose. The Germans have bought a number of old British warships for breaking up, and are laying up old ships elsewhere. It has been stated that they hope to be able to acquire the many old ships in the Soviet Navy, and when these have been broken up, it is anticipated that many of the existing ships in the mercantile navies of the world will be in the market and available to supply scrap for the many steel works in Germany.

The future of the Saar Valley is difficult to foretell; politically its fate is only settled for the next fifteen years. In any case its mineral wealth must exercise a considerable influence in the economic conditions of the countries bordering it, viz., France and Germany.

Railways in 1922.

YEAR by year we have had but little matter to cover in our annual review of railway development. The past year has furnished no improvement; in fact, it is the most disappointing of all, as twelve months ago we anticipated that in it a start would be made on some of the many schemes for which the companies have powers. But it was not to be, for in view of "grouping," the individual companies kept their bank balances as high as possible, and very little was done. In other respects, too, it was a dull year. Parliament was given very little work to do in relation to railways, if we except a Bill to allow the companies to transport goods by road, and even it was eventually withdrawn. There was, it is true, a decided advance towards the restoration of pre-war train services and speeds, but they were purchased, in face of fewer passenger journeys, by an increased passenger train mileage. Now, however, that grouping is practically complete and signs of improving trade are beginning to be manifest, we may hope that our present review will be the last to be written in a minor key.

Grouping of the Railways.

The principal event of the railway year was the progress made with the grouping of the railways. Under the Railways Act of 1921 the twenty principal railway companies in Great Britain were to be amalgamated into four large companies, and they, in turn, were to absorb ninety-three subsidiary companies.

The London and North-Western and Lancashire and Yorkshire companies had not waited for the Act, but had come to terms for amalgamation in the spring of 1921, and the opening of the year 1922 saw the end of the latter company. The announcement

on March 17th that an agreement had been arrived at for the amalgamation of the Midland came as a great and agreeable surprise. On October 25th the terms were announced for the amalgamation also of the Furness, Glasgow and South-Western and Highland. The North Staffordshire, which was to be part of the same group, came in later; its terms were announced on December 19th. The Caledonian, however, remains, as yet, outside. These combined companies are, as so far arranged, to be called the London, Midland and Scottish Railway.

The North-Eastern had, during 1921, come to terms for the absorption of the Hull and Barnsley, and on August 3rd the terms for the amalgamation of the North-Eastern, Great Eastern, Great Northern, Great Central, North British and Great North of Scotland were published. This group is to be known as the London and North-Eastern Railway.

The Great Western carried out its scheme with the greatest speed. Its amalgamation with all the South Wales railways, except the Barry, was approved by the proprietors on February 23rd, and the Barry followed on April 5th. The group retains the name of the Great Western. The amalgamation of the London and South-Western, South-Eastern, London, Chatham and Dover and South-Eastern and Chatham Joint Managing Committee was preceded by the consolidation of the interests of the three last-named into the South-Eastern and Chatham Railway Company, which was subsequently amalgamated with the first-named on terms announced on June 27th. The group, in which the London, Brighton and South Coast Railway was also amalgamated, is now known as the Southern Railway.

Of the ninety-three subsidiary companies, terms for the absorption of forty-three were made public.

NEW WORKS.

We are once again indebted to the chief engineers of the various railways for reports as to the new works continued, completed and put in hand during the year. It should be remarked that some engineers report that attention has mainly been centred on overtaking the arrears of maintenance and renewal accumulated since 1914. This has been the case on the Midland, London, Brighton and South Coast, South-Eastern and Chatham, and the Caledonian, in particular.

London and North-Western.

During the year the laying of fifth and sixth running lines between Chalk Farm and Queen's Park was completed, including two additional single line tunnels at Primrose Hill, and allowed the electric trains to use Euston and Broad-street termini.

The efficiency of the plant employed for breaking up the rock and for the removal of the material by bucket dredgers allowed such good progress to be made with the deepening of the inner harbour at Holyhead, that it is hoped to complete the work next summer. The mail steamers will then berth in the inner harbour, close to the station and hotel, and the tedious train journey between the Admiralty Pier and the station will be avoided.

The other main works carried out by the company are all situate in the Black Country. The station at Walsall, destroyed by fire in 1916, is being replaced by new and improved station buildings, more fitting to the civic importance of that town. A branch, 1 m. 11 c. in length, is being built from the Wolverhampton and Cannock Chase light railway to a new pit of the Holly Bank Coal Company. The goods yard and goods shed at Darlaston are being replaced by new and better accommodation, which will more successfully cope with the growing traffic. A large fleet of motor vehicles is to be stationed there for the quick collection and delivery of traffic in that district.

In the Manchester area the construction of a new road by the Leigh Corporation has necessitated the building of a bridge for the Leigh and Bedford branch, which is of interest in that traffic on the branch is maintained.

Great Western.

Work on the Clydach, Pontardawe and Cwmgorse Railway, which was suspended during the war, has been resumed, and at the southern end the permanent way has been laid between Felin Fran and Clydach, and good progress has been made towards Pontardawe. At the northern end the railway has been completed to Duke's Colliery. The three-mile stretch intervening between Pontardawe and Duke's Colliery will not be put in hand at present.

Four more of the noteworthy wooden viaducts in Devon and Cornwall—two on the Kingswear branch and two on the Falmouth branch—will shortly disappear, as their replacement by solid embankments is approaching completion.

The line at the west end of Newport (Mon.) Station was widened some time ago. The line at the east end is now to be similarly improved by four lines of way being provided up to Maindee West Junction, at which point the line for Cwmbran branches off to the north. This work will necessitate the widening and reconstruction of the bridges over Shaftesbury street and the Eastern Valley Railways, and the erection of the superstructure for two more lines of way on the viaduct over the river Usk. The piers for the latter are already in position. Contracts for the rest of the work have been let.

When railway material was taken up during the war and sent overseas the double line between Clarbeston-road and Johnston (near Milford) was converted to a single line. A year ago we reported that the double line had been restored between Johnston and Haverfordwest, and during the year that between Haverfordwest and Clarbeston-road, 14 m. 8 c., was finished. The portion of the North Pembrokeshire branch between Puncheston and the Fishguard main line at Letterston, 4 m. 27 c. single line, has also been restored, and the single line branch, 6¼ m. in length, from Bearley to Alcester, was reopened as between Bearley and Great Alne, 3 m. 58 c., and an intermediate halt at Aston Cantlow provided.

A commencement was made with the installation of the new system of ventilation for the Severn Tunnel, and tenders were invited for the erection of a station at North Acton on the Ealing and Shepherd's Bush Railway, where is the junction with the Great Western Birmingham main line, and for platforms at West Acton.

North-Eastern.

The works in hand during the year included the new curve, 24 c. in length, between the Dunston Extension Railway and the Gateshead-Blaydon line; the new wagon-building shops at Darlington, which it is hoped to open in the first half of 1923; new car sheds for electric stock at South Gosforth, expected to be completed during 1923; additional sidings for the river Wear Commissioners' new coaling plant at Sunderland; and the strengthening of the High-level Bridge, Newcastle, to accommodate the Newcastle Corporation's trams.

Great Northern.

A new railway, 2¼ miles in length, is under construction from Harworth to Harworth Colliery. The line between the Ouse signal-box and Huntingdon, 1 m., is to be widened. This work includes six new bridges, one of which—over the Ouse—will be of three spans. A new locomotive yard is to be provided at King's Cross. It will be on the down side of the line between the station and Gasworks Tunnel.

Great Central.

The timber viaduct carrying the railway over a navigable creek in the neighbourhood of New Holland is being reconstructed, partly in reinforced concrete, and trains are now passing over the new structure. Two of the works at Grimsby—the reconstruction in reinforced concrete of a portion of the timber fish market and the reconstruction of the entrance to No. 1 graving dock, mentioned herein a year ago—were completed during the year. Tenders were invited for the reconstruction of a further 500ft. of the former. The pier at New Holland is to be strengthened, and a contract has been let for the sinking of 40 steel and cast iron cylinders for supporting the present superstructure.

In anticipation of the additional traffic resulting from the British Empire Exhibition and Sports Stadium at Wembley, the up and down platforms at Wembley Hill are being lengthened and widened, and a new footbridge is to be erected. The latter will be 12ft. wide, cross four lines of way, and be of reinforced concrete. A circular loop and a passenger platform are to be provided at Wembley. The loop will be about a mile in length and between 30,000 and 40,000 cubic yards of earthwork will need removal. Automatic signalling is to be installed between Marylebone and Neasden to permit of a frequent service of trains.

North British.

The reconstruction of Dunninald three-span viaduct on the Aberdeen main line between Arbroath and Montrose, and the reconstruction of the bridge carrying the Carlisle-Edinburgh main line at Carlisle over Wigton-road, were completed. It is hoped that the new terminal basin for the Union Canal in Edinburgh will be finished early this year—1923. The basin is completed, the lifting bridge has been removed to its new site, and the roadways and carting spaces are approaching completion. The reconstruction of that portion of the High-street goods warehouse, Glasgow, which was destroyed by fire, will soon be completed.

London and South-Western.

New Waterloo Station was formally opened on March 21st. At Feltham gravitation yard an engine-shed, capable of stabling forty-two tender engines, is being built in reinforced concrete. A water tank of 120,000 gals. capacity, in the same material, is also being erected, together with a coaling plant, which will have a bunker capable of holding 200 tons of coal. Rockley Viaduct, between Hamworthy Junction and Wareham, which is of seven spans, each of 20ft, is being reconstructed and replaced by one span of 130ft. with steel bowstring girders, resting on cast iron cylinders 7ft. and 9ft. diameter, sunk to a depth of 40ft. below high-water mark. The pier head at Ryde Pier is being renewed in reinforced concrete. The company's permanent way and creosoting depôt at Redbridge is being rearranged so as to conform to modern ideas.

South-Eastern and Chatham.

Three steel bridges on the main line have been rebuilt. The conversion of the swing bridge over the river Stour at Minster into a fixed structure was begun. The new bridge will consist of a centre span of 55ft. and two side spans each of 26ft. 6in. The piers will consist of steel stanchions, carried by cast iron cylinders filled with concrete. The abutments will be of mass concrete on piled foundations.

RAILWAYS AND UNEMPLOYMENT.

Speaking on November 30th in the debate on Unemployment, the Minister of Labour said that the various railway companies had schemes, involving between one and two millions, in contemplation. As some details of these schemes will be of interest, we would say that the London and North-Western Company proposes to widen the line on the west side of Mirfield Station, where the river Calder has prevented the joining up of the four lines of way on each side of the river. This work will necessitate the provision of a costly viaduct over the river; alterations to the station, which is now an island platform served by the two inner lines, with an up goods line and a down goods line outside the station walls, and the construction of the necessary crossover junctions.

There are now only two lines of way between Horbury and Wakefield—Kirkgate—a distance of 3¼ miles, with a tunnel between Horbury and Horbury Junction. The roads are to be increased to four, work which will involve the building of a new station at the junction for the Barnsley branch—Horbury Junction—the opening out or reconstruction of the tunnel, the construction of twelve new bridges, and the removal of 160,000 cubic yards of material, mostly rock.

Two stations in the Blackpool District are to be improved. That at St. Annes-on-Sea will have a bay line for a local service between Blackpool—Central—and St. Annes; platforms lengthened, by 400ft. to 965ft.; new station buildings, and the existing footbridge replaced by a new bridge and a luggage bridge with hoists. At Thornton, between Blackpool—Talbot-road—and Fleetwood an entirely new station is being built. It will have platforms 700ft. long.

The existing station at Bangor was constructed when the Chester and Holyhead line was built by Robert Stephenson. As it is now an important exchange point for the Carnarvon branch and for stations between Bangor and Holyhead and Bangor and Rhyl, the accommodation for the public and for the company's requirements is insufficient. Considerable improvements in the station and yard are, therefore, to be put in hand.

The station at Rickmansworth is to be reconstructed and the electrification extended thence from the junction with the Croxley Green branch. A through service of electric trains will then be possible between Rickmansworth and Euston and Broad-street.

To obtain the necessary clearance for electrically operated stock, certain platform walls, bridge abutments, &c., in the Oldham, Middleton, Royton and Shaw vicinity are to be set back in anticipation of the lines thence from Manchester being converted to electric traction. The principal work of this character will be at Platt Brothers' Hartford Works, Werneth.

The Great Western Company's efforts to relieve unemployment have mainly taken the direction of placing orders for material in industrial centres where the need is most felt. That company's contribution towards relieving unemployment is thus being given indirectly.

The North-Eastern general manager advises us that his company has several schemes under consideration, but the order in which they will be undertaken is a matter for the board of the new London and North-Eastern to decide. The company has a Bill in Parliament to construct a fork between its Leeds and Goole line to join the former Hull and and Barnsley line near Drax, which will allow trains between Leeds and Goole to avoid Selby. Connections are to be laid in near Eastrington between the Hull and Barnsley and the Selby and Hull line, and open the shorter route of the latter for traffic to and from the Hull and Barnsley south of that point. A junction outside the Paragon Station, Hull, will complete the access from the Hull and Barnsley on to the North-Eastern.

The powers sought by the Bill of the Midland Railway is to widen the line from Snydale Junction, 2 m. south of Normanton, to Chevet Junction, 1 m. 56 c. south of Sandal and Walton station. It is proposed to open out Crofton Tunnel 450 yards long and Chevet Tunnel 700 yards long; to replace eleven of the thirteen arches of Chevet Viaduct, 100 yards long, by embankment carrying four lines of way and widen the portion that crosses the West Riding and Grimsby Railway.

SIGNALLING.

There were some interesting developments in signalling during the year; so much so that we feel justified in devoting a section of this annual article to that branch of railway engineering.

The provision of automatic signalling on the under-the-river section of the Mersey Railway, described

in THE ENGINEER of July 7th, is being followed by some interesting work at the Liverpool Central Station of the same company. This work includes the automatic operation of points which, we believe, provides for the arrival of a train in one bay line automatically setting the facing points so that the next train will go into the other bay.

Where facing points are actuated by power the Ministry of Transport places no restriction on the distance such points may be from the signal-box; where they are mechanically worked the limit is 350 yards. During the year there was, at Quainton Road, Metropolitan and Great Central Joint Railway, a pair of facing points, electrically operated from a signal-box 721 yards away. They permitted a signal-box to be dispensed with. The distance for mechanically operated facing points was, until quite recently, 250 yards, and the increase of 100 yards is of great benefit to the companies, as it allows for work in busy stations and yards to be concentrated into fewer boxes and with a consequent reduction in the number of signalmen. The South-Eastern and Chatham Railway is one which has taken great advantage of this concession.

The Great Western has opened a new signal-box at Winchester, wherein is an all-electric power frame of a design much used in France but new to this country. What are known as "route levers" are employed, whereby, on the movement of one lever, all the points and signals for a movement or route are set or held in position.

The success of the daylight colour light signals on the Liverpool Overhead Railway led to the appointment of a Departmental Committee to investigate the potentialities of such signals. The Committee's report appeared on January 11th, and not only was it most favourable to the general use of such signals, but went as far as to say that that type of signal could be arranged to meet all conditions now covered by the existing semaphore type. Major Hall's report on the collision of August 21st near Gravesend recommended the substitution for a semaphore signal of one of these light signals on the ground that it would not only be better suited to the somewhat limited space available, but would give a more arresting signal and one visible at longer range under adverse conditions. Daylight colour light signals are to be provided in connection with the automatic signalling being installed on the Great Central between Marylebone and Neasden.

The report of the Committee presided over by Colonel Pringle, which was appointed in October, 1920, to advise as to automatic train control, was issued on June 21st. It said that a *primâ facie* case for automatic train control had been established, and made certain recommendations. One of these was the immediate formation of a Committee of experts to determine and standardise track and locomotive apparatus, but nothing, we believe, has yet been done in this direction. Like many other matters, it is waiting for the new companies to be established.

The inspecting officers' reports on the collision near Gravesend on August 21st and at Northampton on August 26th said that automatic train control would have prevented those accidents. Four collisions since then—Saint Enoch's, Glasgow, on October 7th; Hornsey on November 14th; Birkenhead Park on December 6th; and Stratford Market on December 18th—would, we believe, similarly have been avoided. It is instructive to note that all six were cases where the control apparatus was necessary at the stop signal only.

The regulation of the running of trains under what is usually known as train control, but were better termed "traffic control," continues to make satisfactory, if slow, progress. The North-Eastern brought a new control office at York into use on November 9th. It will later control the running of all trains between Doncaster and Newcastle. A novel feature of this scheme is that ten cords are provided which suit the varying booked speeds. The markers are attached to these and automatically record the approximate positions of the trains.

RAILWAY ACCIDENTS.

As in 1916, 1919 and 1921, there were three accidents to passenger trains in which passengers were killed. The first occurred on January 27th at Blisworth, when a tender step fell from the engine of an express and, rebounding, hit the side of the first vehicle and killed a passenger. The second happened on August 21st at Milton Range Halt, Gravesend, when three passengers were killed in a collision between two passenger trains caused by the driver of the second passing an advanced starting signal at "danger." The third occurred on December 6th at Birkenhead Park, when the driver of a passenger train overran two home signals and his train collided with another train, killing one passenger. The total number of passengers killed was five, as compared with eighteen in 1921, six in 1920, three in 1919, eight in 1918, twelve in 1917, and three in 1916.

The remarkable feature of the accidents of the year was the number arising from failures of locomotive parts. On January 11th the right-hand connecting-rod of an engine broke at East Horndon, and the driver was killed; on January 27th, as mentioned above, a tender step became completely detached at Blisworth; on April 28th the left-hand connecting-rod of an engine broke at Cheadle Hulme, with the result that a fireman was killed; on May 5th the left-hand connecting-rod of an engine broke at Furness Vale, but there was no fatality; on May 27th a right-hand connecting-rod broke at Manuel, and the driver was killed; on December 4th the crank axle of a six-wheels-coupled engine broke at Castlethorpe, causing the right-hand driving wheel to become detached, whilst the tire of the intermediate wheel was shed. Despite this long list of failures, we feel safe in saying that they do not represent anything abnormal.

An item that should be included under this head was the reading of, and discussion upon, a paper by Colonel Pringle on "Safety in Railway Working" at the Congress of the Institute of Transport on May 19th.

MISCELLANEOUS.

The International Railway Congress was held in Rome between April 18th and May 3rd. The new President of the Institute of Transport was Sir Sam Fay, who devoted his presidential address on October 2nd to "Railway Management." The Scottish companies laid before the Central Wages Board some proposals as to reductions in wages and changes in the conditions of services. The award thereon, which was very beneficial to the companies, was made on January 24th, and on March 17th the men's unions accepted corresponding modifications by the English and Welsh companies. The railway councils necessary to conform to the Railways Act, 1921, were established on April 2nd. On November 12th the companies' and men's representatives met on the invitation of the former to consider further changes in the conditions of service. The discussions were adjourned to allow the companies to submit certain pertinent figures. As was remarked in a leading article in THE ENGINEER of November 3rd, one of the brightest aspects of the British railway situation is the relation between the companies and their men.

Chinese Government Railways.

HEAVY GRADIENT HAULAGE ON THE PEKING-SUIYUAN RAILWAY.

(Contributed.)

THIRTEEN years ago the late Dr. Jeme Tien Liu, then chief engineer of the above-named railway, completed the line from Fengtai, 12 miles south-west of Peking, the junction with the Peking-Mukden and branch of the Peking-Hankow lines, to the old frontier city of Kalgan, known to the Chinese as Chang chia K'ou, the most important place on the caravan route to Urga and Northern Mongolia. Since then the line has been extended past Ta tung fu and Feng chen to Suiyuan, and a further extension to Pao tow chen is now under construction. Distances in miles from Fengtai are roughly as follows:—Peking–Hsi chih mên (West Straight Gate), 12; Nank'ou, the entrance to the pass, 37; Kalgan, 128; Ta tung fu, from which the extensive coalfields in Northern Shansi take their name, 242; Suiyuan, 377; and Pao tow chen, 450.

With the exception of the Nank'ou Pass—that is to say, south of Nank'ou and beyond Kang Chuang—all sections of the line give easy running, and the ruling gradient on the recent extensions does not exceed 1 in 130 very approximately. The negotiation of the pass, however, presented serious difficulties. The gorge is very narrow and the line as completed rises 1630ft. in 8½ miles, giving an average gradient of 1 in 40. There are long stretches of 1 in 30, a reverse at Ching lung chiao, four tunnels at Chü yung kuan, Wu kuei tou, Shih fou ssü shan (Stone Buddha Monastery Hill), and Pa ta ling respectively, the first of which is on a gradient of 1 in 30, and a curve of 600ft. radius uncompensated. Trains, both up and down, are timed at about 10 miles per hour, equivalent to a running speed of about 15 miles per hour. It is perhaps unnecessary to say that this speed limit is a factor of very great importance in the operation of the section.

From the foregoing remarks it will be clear that this "bottle neck" is likely to give trouble even under the most efficient management. That it is causing the railway authorities serious concern is no secret, and the extensions and developments now taking place, especially in the Ta tung fu coalfield, will add to the present difficulties. Although a criticism of the lay-out is outside the scope of this article, the writer considers it not inopportune to say that the general consensus of opinion leans to the view that the authorities concerned would have been fully justified in incurring a much heavier initial cost in order to obtain easier running conditions. It should be remembered, however, that home conditions do not form a safe basis for comparison, as operating expenses have been kept down by making the initial cost in constructing long tunnels, deep cuttings, &c., very high. Abroad these conditions do not always obtain, and usually a quick return for capital expenditure is required. Moreover, speeds are not high and stiff inclines and short radius curves are tolerated.

When this line was first opened "Mogul" type engines, built at the T'ang Shan works of the Peking-Mukden Railway, were supplied for the ordinary train service, both goods and passenger, on the Peking-Nank'ou and Kang Chuang-Kalgan sections, and Shay engines, built by the Lima Locomotive Company, for the Nank'ou Pass section. The latter engines had three cylinders, 15in. diameter by 17in. stroke and 40in. wheels. All the wheels, including those under the tender, were driven through bevel gearing by a longitudinal flexible shaft. The rigid wheel base was 4ft. 10in. and the total wheel base of engine and tender 45ft. 6in. The diameter of the boiler was 4ft. 10in., the working pressure 200 lb. per square inch, and the number of tubes 246. They were 13ft. 6in. long by 2in. diameter. The grate area was 38.8 square feet and the capacity of the tender 4000 gallons of water and 5½ tons of coal. It is understood that these engines have done very good work, but the restricted gear ratio of 1 : 2 makes their upkeep a costly item unless run at very low speeds.

Later, 0–6–6–0 type Mallet engines, some of which were built by the North British Locomotive Company, were put into operation on this section of the line. The leading particulars of these engines are as follows:—Cylinders, 18in. and 28½in. by 28in. stroke; working pressure, 200 lb. per square inch; total heating surface, 2590 square feet; grate area, 45 square feet; diameter of wheels, 4ft. 3in.; rigid wheel base, 9ft. 8in.; total wheel base, 29ft. 4in.; weight of engine, excluding tender, 95 tons; tractive effort, 36,000 lb. Both sets of cylinders are fitted with Richardson's balanced slide valves, anti-vacuum valves and steam-actuated draining valves. Since these engines were supplied "Pacific" and "Mikado" type engines have been put on for passenger and goods service respectively, and larger "Mallet" type engines of the 2–8–8–2 type for the pass section, all built by the American Locomotive Company. The last-named have cylinders 20in. and 32in. by 26in., the high-pressure cylinders being fitted with piston valves and the low-pressure with flat valves, both being actuated by Walschaerts gear fitted with power reverse. Other particulars are as follows:—Heating surface, 2630 square feet; superheater surface, 565 square feet; grate area, 60 square feet; diameter of boiler, 5ft. 7½in.; working pressure, 200 lb. per square inch; coupled wheel base, 13ft. 6in.; engine wheel base, 50ft. 1in.; total for engine and tender, 76ft. 7in.; tractive effort, simple, 67,800 lb., compound, 56,500 lb.; capacity of tender, 6000 gallons and 10 tons of coal; total weight of engine and tender, 185 tons.

Two years ago an order was placed with the same company for seven engines capable of taking 500 tons through the pass. Particulars of these engines, since re-erected at the Nank'ou works by the manufacturers, are given below:—

Cylinders—	
Diameter, high-pressure	24in.
Diameter, low-pressure	38in.
Stroke	28in.
Driving wheel diameter	50in.
Boiler—	
Inside diameter	92½in.
Pressure	220 lb.
Fire-box—	
Length	126in.
Width	108in
Tubes—	
Number, 251	2¼in. diameter
Number, 48	5½in. diameter
Length	24ft.
Wheel base—	
Driving	14ft. 9in. and 14ft. 9in.
Engine	53ft. 11in.
Engine and tender	85ft. 3in.
Weight in working order—	
Leading	28,500 lb.
Driving	388,500 lb.
Trailing	29,000 lb.
Engine	446,000 lb.
Tender	192,700 lb.
Fuel	Soft coal
Heating surfaces—	
Tubes	3534 square feet
Flues	1652 square feet
Fire-box	315 square feet
Arch tubes	37 square feet
Total	5538 square feet
Superheater	1433 square feet
Grate area	95 square feet
Tractive power—	
Simple	111,000
Compound	92,500
Factor of adhesion	4.2
Tender—	
Type	Eight-wheeled
Capacity, water	10,000 gallons
Capacity, fuel	16 tons

A photograph of one of these huge machines, the largest shipped out of the United States, is reproduced on page 42. These engines were delivered early this year *viâ* Tsingtao, and the China staff of the makers has had no light task in erecting them, especially when it is considered that the largest lifting appliance available at Nank'ou, or indeed anywhere on the Suiyuan Railway, consists of four 12-ton chain blocks hung from a timber staging. Fortunately it was possible to jack the boilers up off the railway trucks—see Fig. 1, page 42—and lower them on to their own trucks—Fig. 3, page 42.

The Elvin mechanical stoker fitted to these engines is the standard design and consists of two separate units, *i.e.*, the stoker unit, which is shown in Fig. 2, page 42, in position on the fire-box, and the feeder

and coal breaker unit, which is carried on the tender, the necessary power for both being obtained from a novel reciprocating engine placed under the footplate.

At the time of writing most of the engines have been erected and given a trial run up the pass—running light—afterwards being passed into the railway shops at Nank'ou for cleaning and painting. The actual running conditions, especially through the first tunnel at Chü Yung Kuan, are far from easy. The chimney does not clear by more than 6in. and the down blast is so severe that for the normal running conditions of locomotive behind the train the driver and firemen have to be provided with gas helmets fitted with an air supply pipe which is connected to the Westinghouse system. From actual observations in the pass the engines appeared to run well, and there can be no doubt that they will come up to expectations. In particular the stokers give excellent results, maintaining a uniform fire and a full head of steam.

How long these engines will be kept in an efficient state of repair is a matter of conjecture. In the writer's opinion the facilities for dealing with such monsters are hopelessly inadequate. The majority, if not all, of the engineers on this line have been trained in America, and, coupled with the fact that something more than the ordinary type of locomotive was required, the articulated design and particularly the "Mallet" type became a favourite. Prior to the delivery of these engines the light bridge work entailed restricted axle loading—Cooper's standard E35—thus ruling out heavy consolidation and similar types. Recently the few bridges between Nank'ou and the head of the pass have been strengthened or replaced by structures capable of carrying loads based on Cooper's standard E50, giving a maximum axle driving axle load of 22 tons approximately.

It is with some diffidence that one suggests that the traffic conditions on this section of the line have not yet made it necessary for the authorities to invest in seven engines on such a scale and costing in the aggregate some £170,000. However, in view of the prominence given by the Chinese to the fact that the Peking-Suiyuan Railway has been constructed, equipped, and run without any foreign advice whatever, the latest experiment will be watched by the foreign engineering community in China with a good deal of interest. It is to be understood that the above remarks are not intended in any way as a reflection on the manufacturers of these engines or on the erecting staff at Nank'ou, to whom a full measure of praise is due for work most excellently carried out under difficult and trying conditions.

Electrical Engineering in 1922.

No. II.*

Switchgear.

With the increased size of electric generating units and power stations engineers have had to devote much attention to the design and construction of switchgear suitable for interrupting circuits carrying large quantities of power. During the period under review much important work was done in this direction, and special attention was given by the Metropolitan-Vickers Electrical Company to the design of high-tension oil circuit breakers capable of grappling with the highest voltages and of dealing successfully with the outputs for the largest super power stations. Several circuit breakers were built by this firm for use in the Salford Corporation super power station, these breakers being capable of breaking a load of no less than 1,500,000 kilovolt-ampères. Important orders were received for 11,000-volt outdoor switchgear for New Zealand. As the result of investigations and developments that have been made at the Trafford Park works, the Metropolitan-Vickers Company will be in a position to offer in the early part of 1923 a complete range of ironclad switchgear of small and large capacity and suitable for industrial works, mines, power stations and sub-stations, and for any voltage for which ironclad apparatus is generally suitable. New motor control gear was also developed by the company during the year.

Among the principal switchgear contracts received by the British Thomson-Houston Company during the year was an order for the main power station switchgear for the Nottingham Corporation, the gear comprising twenty-two 11,000-volt equipments with motor-operated oil circuit breakers and high and low-tension auxiliary switchgear. Extensions to existing switchgear constructed with oil circuit breakers similar to those mentioned are being made for the West Ham Corporation, the London Electric Railways, Lots-road power station, the Central Electric Supply Company, and the Lancashire Electric Power Company. In the latter case the work is being carried out in the Radcliffe power station and the new Hilltop sub-station, which links the system with the new 33,000-volt system of the Manchester Corporation. The new Barton power station of the Corporation is the source from which this system draws its supply, and here the British Thomson-Houston Company has carried out the entire switchgear installation, including the 33,000-volt switching equipment, which is one of the most important installations of the kind that has been put into use.

Orders for power-house or extensive sub-station equipments were received by the British Thomson-Houston Company from the St. Pancras Borough Council, the Warrington Corporation, the Wigan Corporation, the Bristol Corporation, the Gravesend Corporation, the borough of Torquay, the London, Brighton and South Coast Railway (through R. W. Blackwell), and the North Metropolitan Electric Supply Company. Thirty-three thousand volt stone-work cubicle switchgear is being built by the General Electric Company, of Witton, Birmingham, for the Cannock Urban District Council and the Gorseinon Electric Light Company.

Transformers.

The most interesting transformer contract which was carried out during the year, was undoubtedly that for the 110,000-volt transformers, which were built by Ferranti, Limited, for Mangahao, New Zealand. Although there is no demand for such high voltage transformers in the United Kingdom, many will be required for places abroad, where abundant water power renders the transmission of current at very high pressures necessary, and it is satisfactory to find that orders for transformers suitable for extra high-pressure transmission, are coming to this country. Besides these 110,000-volt units, Ferranti, Limited, also supplied a number of transformers for use in stations in this country, including ten single-phase forced oil-cooled transformers, for the Birmingham Corporation, each rated at 3500 kilovolt-ampères, and intended to form three-phase groups, each group having a capacity of 10,500 kilovolt-ampères, and a ratio of 5350/33,000 volts.

The Metropolitan Vickers Electrical Company also undertook interesting transformer work, some of which was referred to in our issue of Dec. 1st. Two 18,750 kilovolt-ampère 6600/23,000-volt three-phase transformers were supplied to Newport, Australia, and two 19,500 kilovolt-ampère 6600/33,000-volt three-phase units to the Barton Station of the Manchester Corporation, and four more of these transformers will be supplied early in the present year. These transformers, for the Barton Station, are claimed to be the largest that have been built in this country, and also the largest that have ever been dispatched complete ready for installation. Considerable progress has been made in the design of outdoor transformer stations, and there is now quite an appreciable demand in this country for transformers that are weather-proof. Sixteen 2833 kilovolt-ampère 33,000/66,000-volt transformers of this type have been built for the Manchester Corporation, and they are to be used in three-phase banks, each having a capacity of 8500 kilovolt-ampères. Ten 4667 kilovolt-ampère 6600/33,000-volt single-phase transformers and six 4000 kilovolt-ampère 11,000/66,000-volt single-phase weather-proof units, were also supplied to the Salford Corporation. For extra high-tension distribution in Tasmania the company supplied two 1000 kilovolt-ampère 11,000/88,000-volt three-phase outdoor transformers. It also has an order for ten 1500 kilovolt-ampère 11,000/110,000 distribution transformers for Mangahao, New Zealand. Some of these transformers are to be of the three-phase type, and others of the single-phase type. The company has also shipped to New Zealand and Australia a large number of small distribution transformers for mounting on the poles of transmission lines. Testing transformers are in hand for testing cables up to 300,000 volts.

Converting Plant.

Many rotary converters were put into service during the year, and some of them were of a rather exceptional character. The Metropolitan Vickers Electrical Company, for example, built six 2000-kilowatt sets, nine 1500-kilowatt sets, and three 1200-kilowatt sets. Many smaller machines were also built. Three 1200-kilowatt machines, which suffered damage as the result of fire in one of the Metropolitan Railway Company's sub-stations, were returned to Trafford Park for repairs, and it was found that after eighteen years' continuous service, for approximately ten hours a day, and 365 days a year, the radial wear on the commutators was not more than $^1/_{16}$in. to $\frac{1}{8}$in. At times these machines carried overloads up to 50 per cent., their average load factor being between 80 and 100 per cent. The British Thomson-Houston Company has found the demand for rotary converters to be good. Orders were obtained from, and shipments were made to, Bristol, Glasgow, Leamington, Leeds, Birkenhead, Dundee, York, Edinburgh, Llanelly, Nottingham, Darwen, Wrexham, Norwich, and Luton Corporations, various London boroughs, and also industrial power users and power companies. Whilst remarkable advances have been made in the direction of obtaining larger outputs at given speeds there is, it seems, a tendency among buyers to refrain from purchasing plant running at unduly high speed unless it can be shown that the large outputs are obtained by progress in design rather than by absorbing the margin of robustness existing in the machines of the same output and running at a lower speed.

An example of the progress which has been made in the construction of rotary converters is afforded by the seven 1000-kilowatt, 750-revolution, 25-cycle machines, supplied by the British Thomson-Houston Company to the London County Council and other machines having a similar rating. Although these machines run at a higher speed than those installed previously, they have large overload capacities, combined with excellent commutating characteristics. On account of the necessity for reducing operating costs, much attention has been given to the possibilities of automatic sub-stations in which the plant is controlled and protected, without the presence of attendants. The British Thomson-Houston Company has in hand a large number of these sub-stations for the railways of Australia and South Africa, and is also constructing a complete 2400-kilowatt equipment for the London Underground Railway. The Metropolitan Vickers Electrical Company also reports having received orders of this kind from the Liverpool Corporation, Barrow-in-Furness Corporation, and the Wellington City Council in Ceylon. These sub-stations, which vary in capacity from 200 to 750-kilowatt, are entirely automatic, and work without pilot wires, the stations being designed to start up with a drop in the direct current feeder voltage and to shut down when the load delivered by the sub-stations drops to a pre-determined value.

Peebles La Cour motor converters were supplied by Bruce Peebles and Co., Limited, to South Africa, India, and Japan, whilst a frequency charger and two motor generator sets were shipped to New Zealand. The company was also successful in securing important contracts for converting plant from a number of important supply companies and public bodies in this country.

Electricity in Mines.

As regards mining work, the English Electric Company supplied two electric winders to the Hulton Colliery Company, each equipment being designed to deal with approximately 291 tons per hour from a depth of 2190ft. Other electric winders were supplied by the same builders to the Ocean Coal Company and the Powell Duffryn Steam Coal Company. Many motors for driving fans, compressors, haulages, &c., were also supplied. The Metropolitan-Vickers Electrical Company also received orders for a number of electric winders for use in this country and abroad, the most interesting plant which is now in the course of construction being for the Harworth Main Colliery. The equipment is designed on a new and patented principle. There are two winding motors, each capable of developing 1200 horse-power at a speed of 350 revolutions per minute, and being coupled to the drum through double helical reduction gears. The motors are capable of developing a maximum output of 6000 horse-power, and will be supplied with power from a special turbo generator equipment, which consists of a 1100-kilowatt high-pressure turbine geared to two 875-kilowatt direct-current generators, together with a 22-ton fly-wheel and an eddy current brake. The principle involved is that by varying the speed by 15 per cent. the fly-wheel and turbine are able to deliver up the necessary extra energy required during the acceleration period of the wind, and to store up energy again during the retardation period of the wind as the cage approaches the bank. This enables the boilers to work at a practically uniform rate for the turbine is able to run with a uniform steam input.

A 1125-kilovolt-ampère synchronous induction motor was supplied by the British Thomson-Houston Company to the Powell Duffryn Company for compressor driving. Among other large alternating-current motors which were built by the above firm were two 1500 horse-power 3000-volt 245 revolutions per minute motors, which form part of the Powell Duffryn winder equipment. These are geared alternating-current winders, and are the largest winders of this type that have been installed in this country. Considerable attention was devoted by the Metropolitan-Vickers Electrical Company to the development of apparatus suitable for use in coal mines under the conditions covered by the Home Office Regulation 132. Exhaustive tests were made with explosive mixtures, and new designs of flame-proof and explosion-proof apparatus were completed, including covers for slip rings of induction motors, mining type drum controllers, and a complete line of mining type ironclad switchgear.

Miscellaneous.

There are, of course, other branches of electrical engineering that ought to be considered. In the manufacture of high-pressure cables, for example, there was marked progress. During the year British Insulated and Helsby Cables, Limited, laid, jointed and set to work 20 miles of 33,000-volt cables for various customers, and have another 4½ miles manufactured and ready for laying. One hundred and thirteen miles of multiple twin telephone cable, or 15,949 miles of pair, of which 15,461 miles are balanced, were also made, laid and jointed during the year by this firm, and handed over to the British Post Office. Helsby static condensers, with a total capacity of 7200 kilovolt-ampères, were constructed for power factor correction, and two new types of electric welding machines were put upon the market; one being an automatic seam welder, and the other a

* No. I. appeared January 5th.

butt welder. Some information concerning the progress of main transmission lines is to be found in the second annual report of the Electricity Commissioners, which has just been issued. Permission to run transmission lines was given to the Cleveland and Durham County Electric Power Company, the Gorseinon Electric Light Company, the Midland Electric Corporation, for power distribution, the Scottish Central Electric Power Company, the Swansea Corporation, and the Wolverhampton Corporation. For water power schemes the electrical firms are apparently making a fair amount of plant; most of which is being sent abroad. Besides three water turbines for the York Corporation, which were supplied during the year, the English Electric Company is building a water turbine for the Tata Hydro-Electric Company, for use in the power house at Khopoti, in India. This turbine is capable of developing from 15,000 to 17,000 horse-power when working under a head of 1650ft, and when running at 300 revolutions per minute. Among other generators for coupling to water turbines, the company has in hand two 2500 kilovolt-ampère machines for Waikato, in New Zealand, each being designed to generate three-phase current at a pressure of 5000 volts. Five generators are also being built for the Renala scheme in India, to the order of Sir Ganga Ram, each of these machines being rated at 275 kilovolt-ampères, and designed to give 3300 volts when running at a speed of 600 revolutions per minute. The company is also supplying a 650 horse-power impulse turbine, coupled to a 560 kilovolt-ampère, 600 revolution generator, to the Nepal Government. A fair number of motors seem to have been built for the electrification of industrial establishments abroad by Bruce Peebles and Co., of Edinburgh. Ninety textile induction motors, ranging in size from 10 to 30 horse-power, were supplied to cotton mills in Brazil, and a 290 kilovolt-ampère alternator and eleven induction motors, ranging in size from 10 to 35 horse-power, to a woollen mill in Australia. Other electrical plant was shipped by the company to the Malay States. Developments in electric ship propulsion are referred to in our last issue, where it will be seen that attention is being given to this matter by the British Thomson-Houston Company. An account of all the activities of this company would occupy far more space than can be spared, but we have been particularly requested to mention that good progress has been made at the company's magneto works at Coventry, and that B.T.H. magnetos have been used with great success in connection with many important aeroplane and motor car trials.

At the last moment, and almost too late for publication, the Western Electric Company has sent us some interesting notes on the work it carried out during the year. We gather that the company was moderately busy on the design and erection of various types of central battery manually operated exchanges, both for public service and for private branch work. There is, however, an increasing desire on the part of the users of telephone exchanges gradually to divert from manual to automatic boards, and particularly in connection with private branch exchanges. The difficulty experienced in securing reliable manual operation for offices, stores, hotels, &c., has led to an increasing demand for automatic operation, and the company has introduced full automatic switchboards to meet that demand. The company's engineers were also engaged on the design of repeater stations, for the improvement of transmission on long underground cables, the erection of such stations being very complex and demands highly scientific knowledge.

In the apparatus department the work consisted of supplying the various improved designs of standard telephonic apparatus for both exchange and subscribers' service, and in particular for automatic exchange working. In addition, developments took place in connection with train dispatching systems, tramway control systems, fire alarm systems, and, in particular, the public address system and in wireless broadcasting. The public address system was first introduced to the British public at the Agricultural Hall. The voice of the Duke of York speaking from Buckingham Palace was made to fill the enormous hall with such remarkable clearness that it was fully understood in the remotest recesses. A demonstration of this equipment also took place in the open air, when it was shown that the voice of a speaker, connected by wires or by wireless, could be made to fill an enormous area. It is calculated that, allowing a square yard per person, over a million people would be able to hear every syllable uttered. The knowledge gained in the transmission of speech by electricity over wires has enabled the company to develop wireless transmitting and receiving apparatus having all the refinements which long association with telephony has shown to be necessary if the most satisfactory results are to be obtained, and the company has developed radio sets for almost every purpose. During the year very large quantities of two-way two-valve repeaters were made and supplied for the transcontinental cable for Sweden, and the company is now busily engaged on the manufacture of similar repeaters for the London-Manchester cable.

During the year improvements in the design of telephone cable resulted in a much better balance of circuits being obtained without any increase of cost, and the new type of cable greatly reduces interference troubles and makes the cable more suitable for the operation of repeaters. The company also carried out some further research work in connection with the manufacture of extra high-tension cable. A new type of capacity unbalance testing bridge was also developed by the company.

THE ABER-VRAC'H TIDAL POWER SCHEME.

THE French Chamber has just passed without discussion a Bill for the creation of the experimental tidal electric power station at Aber-Vrac'h (Finisterre). Aber-Vrac'h was chosen for this experimental station because the configuration of the estuary is particularly suitable for the purpose, and because the difference in level between high and low tide is very considerable. Our readers will remember that the proposal is to construct a barrage 150 m.—492ft.—long across the estuary, the top of the barrage being arranged to come 4 m.—just over 13ft.—above the spring tides high-water mark. The barrage is to be constructed of a number of reinforced concrete caissons. The centre caisson, which is to be 35 m.—114ft. 9in.—long and 22 m.—just over 72ft.—broad, will contain the generating machinery, while on the right-hand side of the barrage a lock will be constructed for the passage of fishing craft. It is thought that, according to the height of the tide, the barrage will dam up from 440,000,000 to 660,000,000 gallons of water. The turbines are to be able to operate whether the tide is going out or coming in, a minimum difference in level of 70 cm.—say, 27in.—between the water inside and outside the barrage being required to work them. There are to be two alternating-current generators, each driven by two turbines, and the generated pressure will be 1500 volts. It is estimated that each of the turbines will develop from 75 to 1200 horse-power, according to the state of the tide, and, in order to counteract this irregularity in output and to furnish power during the periods when the turbines can give no power at all, it is proposed to build across the river Diouris, above tide level, a dam 30 m.—say, 90ft. 6in. high—which will impound 12,000,000 cubic metres—say, 2,640,000,000 gallons—of river water, and which, even at high tide, will furnish an available head of 26ft. 3in., the available head at low tide being rather over 95ft. It is hoped by this combination of powers to maintain an uninterrupted service.

It is estimated that a maximum of 4800 horse-power will be furnished by the installation, and that the regular production will be at the rate of 1600 horse-power. It is hoped that the annual output of the power station will be 11 million kilowatt-hours. The expenditure on the installation will, it is calculated, probably amount to 20 million francs.

This is not the only experiment in the control of tidal power in France which has been brought forward. Plans were submitted some time ago to the Granville Chamber of Commerce by a group of American engineers, backed by American capital, for the purpose of undertaking experiments in the Bay of Saint Michel. These plans, it is reported, provide for the construction of a barrier some 12½ miles long across the bay, and it is estimated that the installation should render six thousand million kilowatt-hours annually.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

BOILER PLANT TESTING.

SIR,—At the recent annual meeting of the American Society of Mechanical Engineers, held in New York from December 4th to 7th, 1922, one of the most interesting papers was that giving the results of an elaborate series of boiler tests which have been undertaken at the well-known Connors Creek power station of the Detroit Edison Company, in which the boilers are of the large "Stirling W" type.

These tests have been carried out continuously for nearly five months, and have involved the burning of 12,137 tons of coal, with an evaporation of 101,200 tons of water. They were undertaken with the laudable object of still further improving the efficiency of the steam boiler plant, as compared with the original tests in 1911, and comprise eight series of fifty constant rate tests, using four different grades of coal, and with four different methods of boiler baffling, in addition to a number of other tests in connection with banking up the fires and the modes of operation during the low-load period at night.

It may be stated that the average net working efficiency of the steam generation plant during these elaborate tests was 77.9 per cent., but the chief point of interest is the growing realisation in America of what I consider to be the proper methods of testing boilers. In my recent book, "Boiler Plant Testing," I suggested the adoption of an international code for the testing of steam boilers, and also gave suggestions for such a code. In my opinion, the ordinary general methods as advocated by the British Civil Engineers' code, the present American Mechanical Engineers' code (even in its revised form), and what may be termed the "Continental" code of the German Society of Engineers (in vogue in Germany, Austria, Scandinavia, Norway, and Belgium) are far too academic and unpractical. Thus, as seen in a very striking manner in connection with the question of the duration of boiler plant tests, these codes state that the length of test necessary is comparatively only a few hours, whilst the British Civil Engineers' code actually allows the utterly ridiculous figure of three hours. I have been testing boiler plants for very many years, and I realised a long time ago that the only practical method is to combine a day's test with at least one week's check test of 168 hours, so as to include in the test figures all the losses at the week end and during low-load periods at night, during which time the consumption, in averages, is equal to about 30 per cent. of the coal bill. What is essentially wrong with the existing codes is that the formulators have never been able to realise that boiler plant testing is necessary from the sordid, but vital, point of view of saving money, and that in order to get the best results from any plant it is essential to carry out tests from week to week continuously all the year round as part of the regular routine. The ordinary absurd "official" test of a few hours, generally only when the plant has been erected, is a waste of time, as it is carried out under purely abnormal conditions which bear no relation to the actual burning of the coal from week to week.

The paper mentioned, and the discussion at the general meeting of the American Association of Mechanical Engineers shows, however, that engineers in America are becoming more and more alive to this question of boiler plant testing, and it is high time that we in England followed their example. So far as I know, there is only one boiler plant in this country, namely, Dalmarnock power station, Glasgow, where such methods are carried out at all, and the consequence is that Great Britain—because of this and other misconceptions with regard to boiler plant testing and methods of control—continues to lose about 20,000,000 tons of coal per annum on its boiler plants alone. It seems to me that the great fundamental problem before the engineering world to-day is the elimination of waste of every description, and, like the historical example of the mustard thrown away on plates, this country could live comfortably on what is being squandered through lack of scientific methods.

DAVID BROWNLIE.

Manchester, January 5th.

LAW OF HEAT TRANSMISSION.

SIR,—In your issue of December 22nd you gave an abstract, under the title of "Principles of Boiler Design," from Mr. Stromeyer's report to the Manchester Steam Users' Association, wherein a formula is given which is supposed to represent the law of heat transmission by convection, and was presumably devised by Mr. Stromeyer, but from what data does not appear. Considering the gas side of a boiler heating surface the formula gives

$$H = C\,(T_1 - T_0)\,D_1\,(1 + 0.02\,V_1) \quad \ldots\ldots \quad (1)$$

where H = heat transmitted per hour,
D_1 = density of gas,
V_1 = velocity of gas, feet per second,
T_1 and T_0 = gas and metal temperatures respectively.

Now, this expression (1) may be transposed to the form

$$\frac{H}{T_1 - T_0} = h = C\,(D_1 + 0.02\,V_1\,D_1) \quad \ldots\ldots\ldots \quad (2)$$

It may be assumed that the ordinary law for gases,

$$\frac{\text{Pressure} \times \text{Volume}}{\text{Absolute temperature}} \text{ or } \frac{P\,V}{(T + 460)} = R,$$

is applicable to flue gases without sensible error.

Then, $D_1 = \dfrac{1}{V} = \dfrac{P}{R\,(T_1 + 460)}$

and, as $V_1\,D_1 = \dfrac{w}{a}$

where w = pounds weight of gases per second,
a = cross-sectional area of flow, square feet,

expression (2) may be written

$$h = C\left\{\frac{P}{R\,(T_1 + 460)} + 0.02\,\frac{w}{a}\right\}$$

Let $\dfrac{w}{a} = 1$ say, $P = 2120$ lb. square foot, $R = 53.2$.

Then, if $T_1 = 2000$ deg. Fah.,

$$h = C\left\{\frac{2120}{53.2 \times 2460} + 0.02 \times 1\right\}$$
$$= C \times 0.0362$$

and, if $T_1 = 480$ deg. Fah.,

$$h = C \times 0.0624$$

If it is supposed that C is intended to be a constant for the gas the above results signify that the rate of heat transmission (*i.e.*, per unit of time, area, and temperature difference) increases greatly as the gas temperature falls for a given weight of gas flowing through a given tube. It would be interesting to find out whether Mr. Stromeyer or anyone else can produce any authentic experimental evidence that this has happened between flowing gas and a surface.

The formula is also open to serious criticism in other directions, but it seems hardly worth while to trouble about these at present.

R. ROYDS.

Dundee, January 2nd.

ERRORS OF GAUGING.

SIR,—I have read Mr. Alex. C. Wickman's reply in your issue December 29th to my letter of the 11th ult., *re* "Errors in Gauging," and as he has failed to interpret the meaning of my statement, "By these means an accuracy of transference to ± 0.00002 can be obtained and the finished gauge guaranteed to within 0.00001," I will endeavour to make my meaning clear.

In the first place, the accuracy of transference refers to general transference in the shops from the finished gauge to the work, whilst the remarks on the finished gauge itself apply to gauge-room conditions, both of which are verified by actual practice.

My remarks regarding variation of temperature were intended to refer to the general transference conditions in the shops and not to the gauge room.

T. W. COOPER.

Chelmsford, January 8th.

BRITISH EMPIRE EXHIBITION.

As our readers are aware, the British Engineers' Association, which has been entrusted with the allotment of space in the Mechanical Engineering Section of the British Empire Exhibition, has adopted a different policy from that usual with exhibition promoters, in that it does not issue plans of the hall, inviting people to select their own stand space. Its object is to make the engineering side an effective display, with the exhibits arranged in an intelligent manner. Therefore it invited, in the first place, provisional applications stating the area and frontages desired. Having these particulars before it, it is now able to plan the lay-out of the Machinery Hall in the most advantageous manner. The provisional applications are now being confirmed by binding applications, and the Exhibition Committee will allot the spaces at its meeting on February 1st. We hear that, in spite of the bad times, the applications already in are most satisfactory, and the success of the exhibition from the engineering point of view is assured. Most of the largest and best-known engineering firms in this country will exhibit. It is therefore important that those firms which want to have a good position should send in their applications in accordance with the date given.

A Seven-Day Journal.

The Proposed North Sea Train Ferry.

ACTIVE preparations are under way for the establishment of a train-ferry service between Harwich and Zeebrugge. The company formed in connection with the matter hopes to start operating the service in August. It is receiving the support and co-operation of the London and North-Eastern and the Belgian State railways, and has purchased at an outlay of about £570,000 three train ferry boats built in 1917 for the Government by Armstrong, Whitworth and by the Fairfield Company. It is claimed that Harwich as a train-ferry port offers exceptional facilities by reason of the depth of water available at all states of the tides, the small tidal rise and fall, and the direct access to the Midlands and the North which it affords without touching the London area. The Belgian terminal will be owned by a Belgian company, half the shares of which will be held, and half the directors appointed, by the British company. The service will provide a through connection, not only with Belgium, but with France, Switzerland and elsewhere on the Continent. In order to facilitate the working of the service, the Commissioners of Customs and Excise have, it is stated, consented to an arrangement under which goods arriving in properly padlocked wagons will be examined for Customs purposes at their inland destination, so as to avoid any delay at Harwich. The train ferry boats, we understand, are those operated during the war from Richborough and Southampton. They have a length of 350ft., a breadth of 58ft. 6in., and a mean draught of 9ft. 6in. They are propelled by triple-expansion engines, and develop a speed of 12 knots.

Trials of Marine Oil Engines.

As has already been announced, the Institutions of Mechanical Engineers and Naval Architects are organising trials of marine oil engines and of motor-driven vessels. The Committee appointed to deal with the matter has, with the sanction of the Admiralty, been joined by the Engineer-in-Chief of the Navy. The trials are to include economy and thermodynamic tests on shore and manœuvring tests at sea. Wherever possible, the behaviour of the propellers and the hull will be examined. It is anticipated that the first actual testing work will be carried out round about April.

Swansea Harbour and the Great Western Railway.

A BILL has now been prepared and deposited for introduction into Parliament during the next session under which the undertaking of the Swansea Harbour Trustees will be taken over by and absorbed in the Great Western Railway system under the Railways Act of 1921. The consideration for the transfer amounts to a total of £4,370,130, and involves the paying off of mortgage principals of £757,900, the repayment to the chairman of the Trustees of £63,135 advanced by him to the undertaking without interest, the conversion of a total stock of £3,612,230 at the rate of £80 Great Western 5 per cent. stock per £100 Harbour Trust 4 per cent. stock, and the payment of all arrears of interest on the mortgages and stocks, which interest has been in default since January 1st, 1920.

The Penlee Lifeboat.

IN our issue of December 22nd we described the Penlee lifeboat, The Brothers, which is noteworthy as being the first lifeboat to be fitted with the Institution's new 90 horse-power marine petrol engine. The lifeboat proceeded to its station about the middle of December, and during the voyage heavy weather was encountered. Last week the boat performed her first service under exceptionally trying weather conditions. A foreign steamer of 3700 tons went aground on the Runnelstone Rocks, and the Penlee boat was successful in rescuing twenty-seven men and landing them safely at Newlyn. The position of the wreck was such that the lifeboat had to work within 20 yards of the rocks during a fierce gale, and while the men were being taken off the ship the boat was continually washed over by heavy seas. Despite the arduous service conditions, the machinery, we hear, responded to the demands made upon it, and the engine showed itself to be thoroughly fitted for the work for which it was designed.

The Therm Inquiry.

THE third meeting of the Board of Trade's Departmental Committee appointed to inquire into the method of charging for gas on a thermal basis was held on Tuesday. Mr. Trifitt, assistant engineer, North-Eastern Railway, favoured the retention of the thermal basis, but complained that certain safeguards dealt with in the Fuel Research Board's report were not incorporated in the Gas Regulation Act, or, if incorporated, were not being enforced by the gas referees. He urged that the minimum pressure should be tested, not at the gasworks, but at the outlets from the consumers' meters, that the gas companies should be required to install continuously recording calorimeters, and that each private consumer should be provided with a pressure governor at his meter. In a certain area, his company had experienced an economy of 42 per cent. by the introduction of a pressure governor. Mr. Goodchild, gas and hydraulic engineer, London, Midland and Scottish Railway, supported Mr. Trifitt in his views, and expressed the opinion that the installation of governors should be made compulsory, the cost to be borne equally by the company and the consumer. Dr. Hartley, chief chemist to Radiation, Limited, dissented from the opinions expressed regarding governors, and said that such devices would not prevent variation of pressure at the different gas appliances in a house. Mr. Watson, governor of the Gas Light and Coke Company, supported Dr. Hartley's view. The tap was, he said, the best form of governor. Automatic governors had been tried by many people, and had been abandoned as nuisances. To fix governors to the meters would, in the case of his company, involve an expenditure of £1,200,000 and an annual upkeep charge of £150,000, or at the rate of 3d. per 1000 cubic feet.

Secret Naval Patents.

BEFORE and during the war naval officers and men were responsible for a large number of inventions which were made the subject of secret patents. Although a considerable number of these patents must in the interests of the Navy continue to remain secret, the Admiralty has decided that there is now no objection to the re-assignment and publication of certain of the older secret patents, and is prepared to give careful consideration to applications for re-assignment from patentees who believe that advantage thereby will accrue to the public generally and to themselves.

The Safeguarding of Industries Act.

THE agitation in favour of the repeal of the Safeguarding of Industries Act is undoubtedly growing in volume, notable assistance in this direction having been lent by the result of the ballot recently taken among its members by the Manchester Chamber of Commerce. Replying to the agitation, Mr. Godfrey Cheesman, general secretary of the National Union of Manufacturers, an organisation which took a large share in the responsibility for the passing of the Act, makes light of the suggestion that the Act has in any way damaged the country's industries. So far, he says, only a few orders have been made under the Act. In one trade to which it has been applied, a certain very large firm, according to Mr. Cheesman, has since an Order was put into force, trebled the number of its workpeople, and kept its plant in continuous working. Its output has greatly increased, and it has been enabled to sell its products at prices which are less than those charged for similar German goods before the war. The policy of the National Union of Manufacturers, according to Mr. Cheesman, is to bring about a policy of what he terms "common-sense protection," an expression which he interprets as meaning "the power to impose tariffs for bargaining purposes."

Jubilee of the Metropolitan Railway.

ON Wednesday the Metropolitan Railway of London celebrated its diamond jubilee, for it was on January 10th, 1863, that the first 3¾ miles of line, between Paddington and Farringdon-street, was opened, with great ceremony, for public traffic. The construction of a London underground railway had been discussed for the previous twenty years, some of the ideas advanced being fantastic in the extreme. After great opposition, the company secured an Act of Parliament authorising it to construct the railway, and started work about the middle of 1860. Money was difficult to find, trouble arose with the Great Western and Great Northern railways, and the claims for compensation were most extravagant. Yet, with the assistance of Mr. Charles Pearson, matters were smoothed down, and construction was completed in about 2¼ years. The public patronised the railway in large numbers, the first three week showing an average of 29,196 passengers per day, and an average daily receipt of over £346. Preparations for extending the line were at once made by the directors, fresh capital was secured, and the line was extended first eastwards to Moorgate, then westwards towards Kensington, and thereafter by the absorption of the St. John's Wood line to Swiss Cottage as the northern terminus. Much criticism was levelled against the company by reason of the choking of the tunnels with smoke and fumes. The company's engineer, Mr. (afterwards Sir) John Fowler, experimented before the railway was opened with a "hot brick" engine, in which the water was heated by means of bricks at a white heat in a chamber within the boiler barrel. An engine of this description was actually constructed, but a trial run on the Great Western Railway in October, 1861, led to the idea being abandoned as impracticable. The trouble was not cured until the railway was electrified in 1905. For the first six months of its life the line was worked with Great Western broad-gauge rolling stock, but in consequence of a disagreement between the two companies, narrow-gauge working had to be resorted to at seven days' notice.

Problems of the British Motor Car Manufacturer.

ADDRESSING the Midland Council of the National Union of Manufacturers at Birmingham on Monday, Sir Herbert Austin dwelt on the serious import to British motor car manufacturers of the facts revealed to him in the course of a recent visit of inspection to the United States. American manufacturers, he said, were now selling substantial cars to foreign agents for a smaller sum than that which the British manufacturer would have to pay for the material required for a similar size of car. In other words, if the British manufacturer had no overhead charges, obtained his labour free, and was content to do without profit, he would just be able to compete with the American in point of view of price. It is difficult to reconcile this statement with the further one made by Sir Herbert that the average rate of pay in the American factories is two and a-half times as high as that paid in British establishments, even although we accept his opinion that the American worker has twice the output of his British fellow. Sir Herbert complained that in Great Britain there were far too many makers of motor cars, and far too little co-operation between them and the makers of the accessories and components.

The Admiralty Transport Arbitration Board.

IT is announced that Lord Trevethin has been appointed President of the Admiralty Transport Arbitration Board in place of Viscount Mersey, who has resigned. Sir James Warrack, of Edinburgh, is to be Vice-president, in succession to Sir William Watson, who has also resigned. Sir Gerald Chadwyck-Healey, R.N.V.R., has joined the Government Nominees' Panel, from which members of the Board may be chosen. His predecessor was the late Captain Sir Charles Chadwyck-Healey, R.N.R.

Sixty Years Ago.

IN our issue of January 9th, 1863, we reprinted a paper "On the Density of Steam," read before the Royal Society of Edinburgh by Macquorn Rankine. Two years or so previously, Fairbairn and Tate had carried out a series of experiments on the density of steam at different temperatures. Rankine's paper was directed towards comparing the experimental results with those indicated by the mechanical theory of heat. By means of the Rankine-Clasius "general equation of thermodynamics," he arrived at a formula for "computing the volume of a vapour from its latent heat." The calculated and experimental results showed in general close agreement. The erratic nature of the differences combined in one or two instances with their actual magnitude, seem to have caused Rankine some uneasiness, and to have led him to admit the possibility of some discrepancies in Regnault's steam tables. In an article on "Lenk's Gun-cotton Artillery System," we read that Baron Lenk, an Austrian, had succeeded in overcoming the difficulty hitherto experienced in using Schönbein's gun-cotton, discovered in 1849, by varnishing it with "soluble glass" to eliminate its hygroscopic nature, and by giving it a form equivalent to the grain of gunpowder. To secure the latter result he prepared the material in the form of cords. This article foreshadowed the development of cordite and its use as a propellant. Details were given of the manner in which the rent in the bottom of the Great Eastern was repaired—see last week's Journal. As no dry-dock existed large enough to hold the ship, she had to be repaired while afloat. A channel-shaped coffer dam of oak was sunk beneath the ship and pulled up tight against the rent in her bottom by means of chains passed round her hull. The interior of the coffer dam was then pumped dry, and workmen entered it through chutes opening above the surface of the water. The junction between dam and hull was made water-tight by using an india-rubber water hose as packing. In a note entitled "Something New in Sails," we read that the advent of the turret ship had led to plans being laid before the Admiralty for an "entirely novel" method of masting and rigging our "sea-going and iron-clad ships." The basis of the plan was the use of tripod tubular iron masts without lower stays. The idea was eventually adopted in the Dreadnought in 1906.

A Large Switchgear Works.

THE importance of employing good switchgear in central stations and sub-stations is well recognised by electrical engineers. In the early days of electricity supply undertakings many troubles originated on the switchboard, but, thanks to the ingenuity of electrical designers, it is now possible to run stations which are very much larger than those built in the past with very little fear of anything serious happening. Fatal accidents and fires on some of the early switchboards emphasised the need for radical changes in the design, and one of the firms that set out to remedy the old defects was A. Reyrolle and Co., Limited, of Hebburn-on-Tyne. By the development of the well-known concentrated form of switchgear in which air spacing is abandoned and complete reliance is placed upon insulating materials, for the separation of the bus-bars from one another and for the insulation of the interconnecting conductors throughout the gear, it became possible to enclose the entire gear in protective armour, composed either of cast iron or steel plate, according to requirements.

A factor in electric power supply which greatly influenced switchgear design was the need for a switch capable of interrupting a circuit carrying as much as 1,500,000 kilovolt-ampères, and as a result of this the manufacture of central station control gear rapidly passed into the realm of heavy engineering. The works of A. Reyrolle and Co. have grown from quite small beginnings, and at the present time they give employment to no fewer than 1100 people, and produce on an average 140,000 kilowatts of armoured switchgear every week. It is believed that there is no other factory of equal size in this country that is devoted entirely to the manufacture of switchgear for power station, sub-station and general industrial switchgear, or no factory of the kind that is laid out on better lines. The importance which the firm attaches to the insulation used in the gear is well demonstrated by the rigid tests to which the materials are subjected. The covering of the conductors, ranging from wires of small sections to the heaviest rectangular laminated bus-bars, is carried out with as much care as that bestowed upon the windings of turbo-generators or the high-tension coils of a heavy duty transformer. The many and varied operations upon the metal casings which enclose the numerous patterns of the firm's armour-clad gear are effected upon modern machine tools, a tool of special interest being a large grinder which has been installed to face up the surfaces of the joints in the outer armour which is employed in all types of the gear. In the shops in which the high-tension switches are assembled there is an elaborate jig equipment, which makes it possible accurately to centre and align the switch contacts, the interconnections, the bus-bars and other conductors. Some idea of the size of the jigs may be gathered from the fact that a jig used for a 44,000-volt 15,000-kilowatt switch weighs no less than 5 tons.

The extra high-tension equipment of the works has been devised on lines which make it extremely difficult for any piece of apparatus to pass through with the slightest flaw. Transformer equipment is installed which gives a range of pressures up to 200,000 volts, and this maximum pressure can be applied to any switch or section of gear with complete freedom from risk to the testing operator. Although the capital cost of this portion of the works is high, it is felt to be in every way justified. Since the advent of armour-clad switchgear there has been a great reduction in the space occupied by switching equipment, and the Reyrolle control gear for a super power station can be installed in such a manner as to give ready access to every section and to place the whole of the apparatus within sight.

The site on which the works stand comprises over 5½ acres, the buildings at present covering 3½ acres. The main building of the works is 200ft. long by 200ft. wide, and is divided into five bays, having a width of 40ft. The five shops are served by overhead cranes with lifting capacities ranging from 5 to 15 tons, and a standard railway track is run into the centre of the side sections. The tool equipment includes a planer milling machine, with a table 13ft. 6in. long and 5ft. wide, and capable of handling castings weighing as much as 15 tons, this machine being driven by a 24 horse-power motor. In the main machine shop there is a great variety of lathes, drills, shapers, slotting machines, grinders, &c., and a specially designed machine for drilling square holes. There is also a large double-spindle vertical drilling

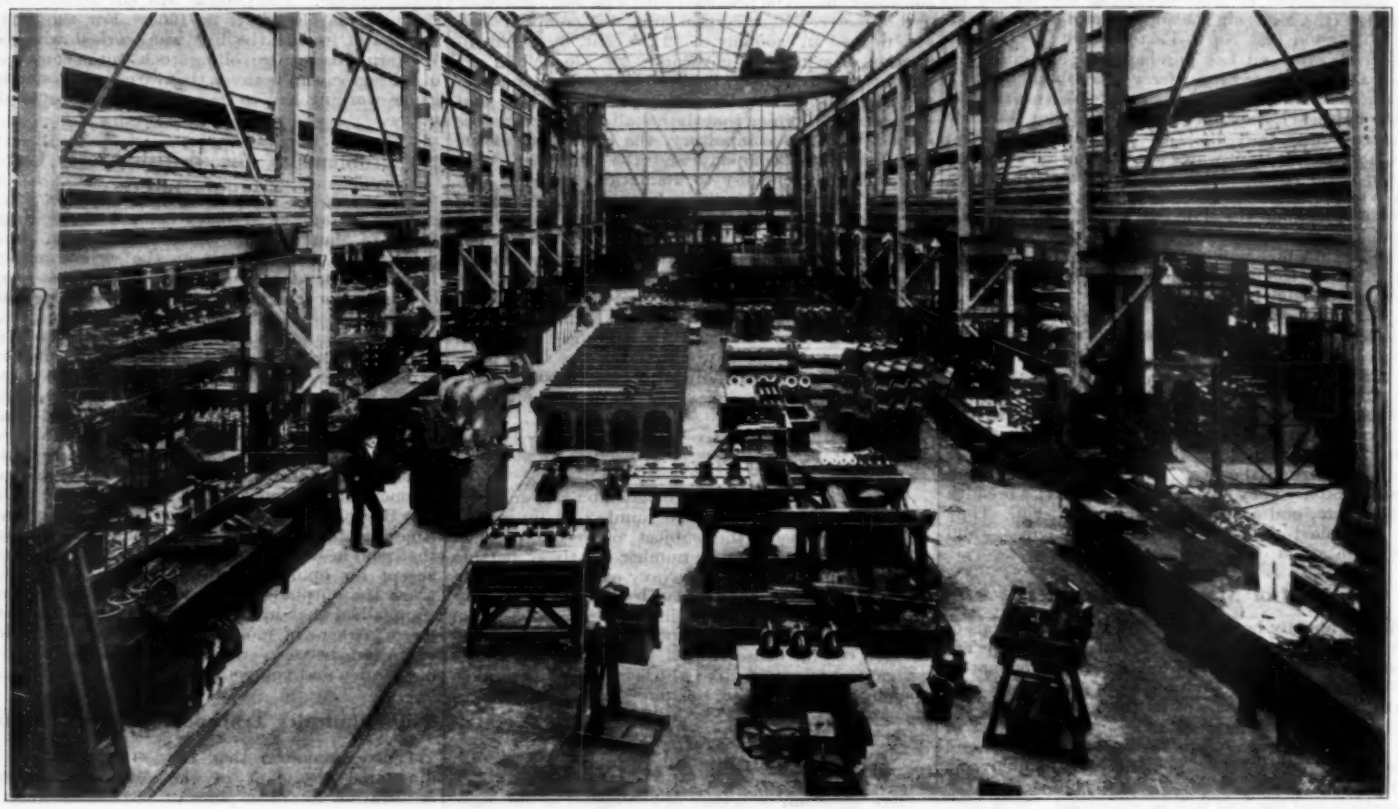


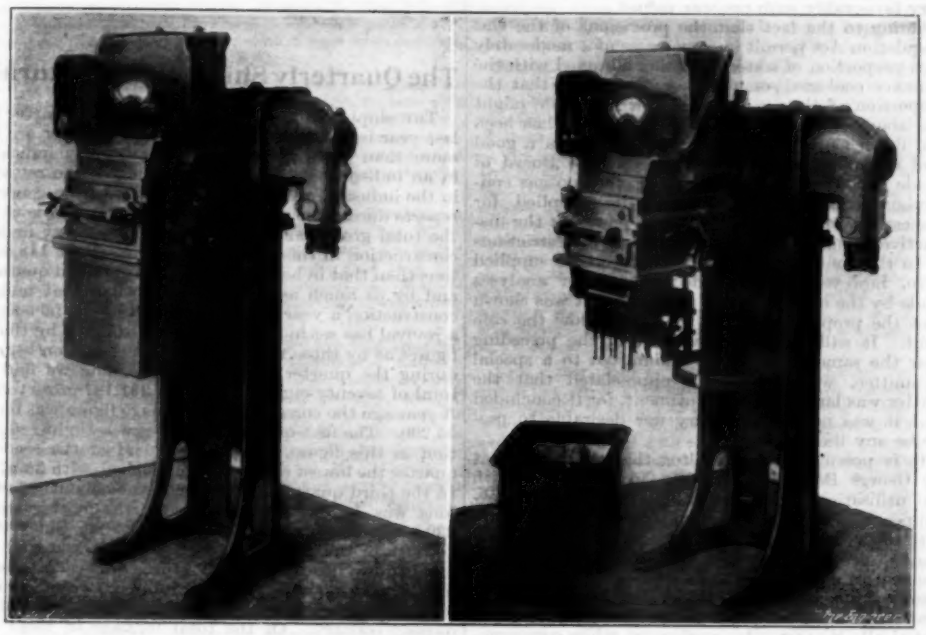
FIG. 1—ERECTING SHOP

FIG. 2—COIL WINDING DEPARTMENT

FIG. 3—TEST ROOM

machine, which has a radius of 7ft., and is capable of drilling holes up to 3in. diameter, the machine being driven by a 9 horse-power motor. Another tool of considerable interest is a large grinding machine, 16ft. long, which is driven by a 30 horse-power motor, which drives a spindle carrying a wheel 52in. diameter, with inserted carborundum segments dovetailed in position. This grinder is used to face up such surfaces as steel top plates of switches and faces of joints on castings forming the chambers for bus-bars, switch panels and sealing bells, &c. In the large shop parts and complete panels are assembled.

The high-tension testing section occupies a space



FIGS. 4 AND 5—FLAME-PROOF SWITCH

of 120ft. by 40ft., and is served by a 5-ton overhead crane. Arrangements are now completed for providing an entirely new testing laboratory in which will be installed transformers giving a range from 0/450,000 volts. The transformer which is capable of giving this pressure range is connected to an induction regulator, which is connected in turn to the supply company's mains, which give a pressure of 5500 volts. This regulator is capable of regulating the primary voltage from 0/11,000, and it varies the voltage, on the secondary side, from zero to a maximum of 450,000, the regulator being capable of adding to, or subtracting from, the supply voltage. Immediately adjoining this building is a packing department, in which a standard railway track is laid, the packing floor being served by an overhead crane having a lifting capacity of 5 tons.

At the north-west side of the site is a two-storey building, 242ft. long by 40ft. wide by 42ft. high. The upper storey serves as an insulating and transformer department, and also for the production of large quantities of plugs and sockets up to 30 ampères capacity, and other small repetition work. The ground floor is arranged for the fitting and assembly of mining type switchgear, and at one end of this shop is a section in which varnishing, black enamelling and stoving is carried out. The space between this building and the main building has recently been roofed over, thus giving an additional shop 242ft. long by 25ft. wide, which will permit of the provision of a separate department for the erection of control boards.

The patternmakers and joiners shop is a separate building, one storey high, and is 120ft. long by 40ft. wide. Its tool equipment includes planes, band saws, lathes, circular rip saws, &c., driven from motors fitted in a trench beneat the machines.

A few small shops covering an area of about 30,000 square feet, which formed the original works, are now used partly as stores and partly for light machine tool work. The offices, which have recently been extended to the extent of 7000 square feet, are roomy, well lighted and are heated by hot-water radiators, provision being made in the wiring system for electric fires. The drawing-office covers an area of 5800 square feet.

The electric power is supplied to the works by a high-tension feeder at 6600 volts from a three-phase system of the Newcastle Electric Supply Company. This feeder is brought through Reyrolle sealing bells into a 270 kilowatt transformer of the outdoor type, situated in the open yard. The total load connected in lighting, power and heating involves the consumption of 2900 units per day, part of this power being utilised in an electrically-equipped kitchen, from which meals are provided daily for the workmen and the staff.

The firm has recently completed some very important contracts, representing a total capacity of 3,031,000 kilowatts, and effecting a saving of 598,300 cubic feet in building capacity. Some extensive and very interesting switchgear work is also in hand. The switch illustrated in Figs. 4 and 5 is a 200 ampère three phase flame-proof switch of the draw out type, and is fitted with coke leakage protective gear. Fig. 1 shows one of the departments of the works in which switchgear is erected, whilst Figs. 2 and 3 show the coil-winding and testing departments respectively. Fig. 6 shows a set of 33,000 switch units, built for the Manchester Corporation; and Fig. 7 some 6600 ironclad draw-out type gear which has been built for India.

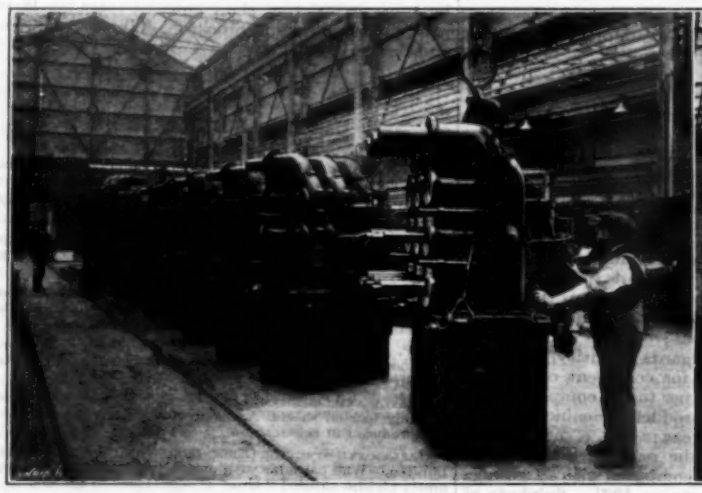


FIG. 6—33,000-VOLT SWITCH GEAR

FIG. 7—6600-VOLT SWITCH GEAR

Gas Engineering in 1922.

So far as the past year was concerned there were no outstanding developments in the technique of towns gas production; but progress of an unostentatious though valuable nature is to be recorded, and from the standpoint of its relation to the service of the public, the use of gas continued to make headway. It is a remarkable and gratifying fact that the extent to which gas is used continues to increase in spite of the strides which are being made by electricity; and this fact in itself should be sufficient to indicate that there is to-day ample room for both commodities, and that in many ways their applications lie in different rather than in parallel directions. Each has its definite uses, and consumers would appear to be learning which gives the better service for certain definite purposes. Even the layman has ceased to characterise the gas industry as moribund, and the visionary who points to a time when gas and electricity will join hands for the benefit of the community as a whole, and the nation in particular, is probably not altogether concerning himself with a chimera.

As compared with many of his colleagues in industry, the gas engineer certainly had cause to congratulate himself on the course of events in the past year as a whole. The preceding year, interrupted as it was by a protracted coal dispute, was one of exceptional anxiety; and though the aftermath of the coal trouble had its influence on the financial situation of the gas undertakings in 1922, there were many compensations, such as an appreciable fall in the cost of gasmaking coals—the value of which stood at nearly half that of 1920—successive reductions in the cost of labour, and freedom from anything in the way of labour disputes. Towards the middle of the year consumers of gas—backed by an active campaign in the daily Press—began to show a certain amount of disrespect for the therm system of charging. It was evident from the opinions expressed that the public was wholly unable to appreciate the operation or significance of the new system, and it was an unfortunate fact that its introduction synchronised with a period when the price of gas, largely owing to conditions which were beyond the control of the suppliers, was standing at almost the highest level it had ever reached. This criticism was quickly met by a reply from the Fuel Research Board, which issued a booklet, entitled "The Therm," in which a clear and non-technical presentation of the true facts of the situation was given. The majority of consumers were undoubtedly labouring under the misconception that the new basis of charging for gas had been introduced by the gas undertakings themselves; but it was made amply clear that the whole problem to be faced by the gas-supplying industry and the country after the war was referred to the Fuel Research Board by the Board of Trade. Moreover, it was essentially the Fuel Research Board which reached the conclusion that, in the interests of the economy of our fuel resources, the gas undertakings ought to be allowed more liberty in determining the composition of the gas they supplied, since local conditions varied in different parts of the country, and since there was a varying local demand for the different by-products which could be obtained by different methods of manufacture. The Board also found the then existing checks on the heating quality of the gas supplied through the mains to be inadequate, and the tests required by the Acts to

be insufficient to secure that the undertakings supplied gas of a uniform and stated heating quality. Further, it was clear that the interest of the consumer, while it required the encouragement of the most economical methods of producing gas, could only be secured if he were charged for the heat which the gas supplied to him would provide when burnt in properly-adjusted appliances. At a series of conferences these principles received the general support of representatives both of the gas industry and of the consumers, the result of which was the Gas Regulation Act, the provisions of which are now comparatively well known.

The Price of Gas.

In spite of the assurances which were given by the gas undertakings as to the absence of any relation between high gas accounts and the therm, representations on the matter continued to be made, and towards the end of the year the President of the Board of Trade agreed to appoint a committee of inquiry into the operation of the new system. This Committee, of which Sir Clarendon Hyde was chairman, began to hear evidence from all interested parties in December, and at the end of the year it was still engaged in its task. The main point which emerged from the inquiry so far as it had gone, was that the form of account as adopted by many undertakings required the exercise of a certain amount of technical knowledge and arithmetic, and it would seem that a great deal of the misunderstanding could be effectively removed by a clearer presentation of the consumption, *i.e.*, in cubic feet as well as in therms.

As a matter of fact, although the price of gas in the earlier months of the year was comparatively high, the public stood to gain by the free excess of heat units which many undertakings had distributed over and above their statutory obligations. Attention was drawn to this bonus in an editorial article in THE ENGINEER for May 26th last, where it was pointed out that a continuance of such generosity could not be expected, for margins of the kind would necessarily involve the undertakings in serious losses of revenue. As an example, the case of the South Metropolitan Gas Company was quoted, and it was shown that if that undertaking continued to distribute surplus heat units to the extent which they were distributed in the first three months of the year, it would suffer a loss of revenue approaching £50,000 per annum. While the Gas Regulation Act was still more or less a novelty, it was to be expected that certain anomalies would occur. It was not, therefore, surprising to find that during the year quite a number of undertakings signified their intention of modifying the "declared calorific value" which they had originally selected. The most noteworthy instances of such modifications were the Gas Light and Coke Company, which raised its declared value from 475 to 500 B.Th.U.; the South Metropolitan Gas Company, 550 raised to 560 B.Th.U.; Plymouth Gas Company, 425 raised to 450 B.Th.U.; and Sheffield Gas Company, 480 raised to 500 B.Th.U. Official statistics issued during the latter part of the year indicated that certainly in the Metropolis and suburban areas the gas undertakings had progressed considerably in the direction of working more closely to their standards, and it must at least be said that the requirements of the Gas Regulation Act have impelled a close study of the problem of producing a gaseous mixture of uniform quality. As an example of the apparent disparity of gasmaking processes, attention should be drawn to the fact that at the end of the year all three of the undertakings which supply the Metropolis were operating on different declared values. This is a point which, from the standpoint of the consumer, might well receive attention with a view to some attempt at standardisation being made. Moreover, it might well be asked why the recent policy of amalgamation of interests, or grouping, adopted by the railways should not be extended to the gas undertakings serving greater London, or, at any rate, the Metropolitan area. North of the Thames one finds, for instance, one comparatively large undertaking which is surrounded on every side by the Gas Light and Coke Company, which operates on a declared value different from that of the latter company, and whose distribution area could no doubt be fully supplied by existing works of the bigger undertaking. In such an instance it would seem that amalgamation could not be otherwise than a potent factor in the quest for cheaper gas.

The Presence of Carbon Monoxide.

As is customary, the fall in the price of coal was accompanied by a fall in the value of coke; but in spite of a lower revenue from residual products, it was possible to make successive reductions in the price of gas during the year. In London at the commencement of the year a therm price of about 1s. 1d. prevailed; but by the end of the year all of the metropolitan undertakings had reduced their prices to 10d. per therm, while one company announced its intention of supplying its consumers at 9d. per therm from the beginning of the present year. It is difficult to predict what further reductions may be made before the price becomes more or less stabilised; but it may be mentioned that at Bath the record figure of 5½d. per therm has been reached. It is as well to bear in mind that the consumer has not yet learnt to appreciate what a considerable advantage he reaps by even a small reduction in therm cost. For instance, when an average quality of gas—say, 500 B.Th.U. per cubic foot—is supplied, there are no less than five therms in a 1000 cubic feet of gas, so that when a reduction of 1d. per therm is made it means an equivalent reduction of 5d. per 1000 cubic feet. Very close consideration and economy in working are required before such a reduction can be put into effect. Assuming, however, that no unforeseen incidents occur during the present year, it is more than probable that gas in London may be sold for 8d. per therm. That would mean, approximately, an equivalent price of 3s. 4d. per 1000 cubic feet, which, considering the changed conditions, compares very favourably with pre-war values.

Owing to the fact that the provisions of the Gas Regulation Act permit in some cases of a moderately high proportion of water gas being admixed with the ordinary coal gas, some fear was expressed that the proportion of the toxic gas carbon monoxide might rise above the limit of 20 per cent. which has been laid down as safe. The question was given a good deal of prominence, and as a result the Board of Trade issued an order to the effect that no gas containing carbon monoxide must be supplied for domestic purposes unless such gas possesses the distinctive pungent smell of coal gas. No restrictions as to the content of CO in the mixture as supplied were, however, recommended, and from analyses made by the official testing authorities, it was shown that the proportion of CO was well below the safe limit. It will be recollected that in the preceding year the same question was submitted to a special committee, which evidently appreciated that the matter was largely one of sentiment, for it concluded that it was neither necessary nor desirable to prescribe any limitations.

It is possible, but not altogether probable, that Sir George Beilby's suggestions in connection with the utilisation of the gas obtained from the low-temperature carbonisation process for admixture with towns' gas may some day be carried into effect. The prospect of the gasworks of the country becoming the centres of a smokeless fuel industry is attractive from a Utopian point of view; but the gas engineer conducts his present process with the knowledge that technically it approaches perfection, while commercially it is certainly capable of guaranteeing solvency. It cannot be denied that in the able hands of the Director of Fuel Research, the technical difficulties associated with the production of semi-coke have largely disappeared; but the more serious unknown factor is the commercial abilities of the system. Products whose value is subject to wide fluctuation play so prominent a part in the process that it would appear to be one which might well alternate between prosperity and acute depression.

In a report issued by the Fuel Research Board, Sir George Beilby remarked that the realisation of a reasonable margin of profit must depend on the evolution of apparatus which could be cheaply erected, worked, and maintained, and of which the yields and qualities of the products would conform to the standards reached in the experimental work at the Fuel Research Station. The report dealt at length with the types of apparatus which have been experimented with at the station and by outside inventors, and the view was expressed that, with the accumulated experience which is now available, the ultimate solution of the technical problem might be arrived at on lines which are now being developed. It was suggested that a special study which was made of the micro-structure of cokes prepared from different coals and from blends of caking and non-caking coals might lead to the establishment of a link between low-temperature carbonisation and the coking and metallurgical industries.

Residual Products.

So far as the more important residual products were concerned, the position throughout the year could be characterised as good. In proportion, the fall in the value of coke was rather more pronounced than the drop in the price of coal; but the export trade remained satisfactory as regards quantity, although the average price received for coke sent out of the country was only some 30s. per ton as compared with £6 in 1920. Tar and its products remained a good market throughout the year; and a noteworthy improvement occurred in the price of pitch, which soared to over £6 per ton, as compared with an average value of only half that figure in 1921. Sulphate of ammonia is always an important product, and the manner in which it fares is invariably interesting, owing to the possibility of its meeting with severe competition from synthetic sources. The situation was considerably assisted by the scarcity in America resulting from the coal stoppage there, the result being that supplies for export continued to be short, and the price rose accordingly. At the end of the year the export price stood at about £19 per ton, home prices being fixed at £16 18s. for neutral quality, and £15 5s. for ordinary salt. So far as competition from synthetic sources was concerned, it was pointed out that Germany is unlikely for some time to produce more nitrogen than she requires for her own consumption. Indeed, owing to the great explosion at Oppau in October, 1921, which entailed a loss of three months production, and to subsequent difficulties of transport, Germany's supply of nitrogen for 1921-22 was not equal to her home demand, and about 20,000 tons of nitrate of soda were imported. Germany could, under present conditions, probably consume annually about 340,000 tons of pure nitrogen, equal to about 1,700,000 tons of sulphate of ammonia; her production last season has been given as 290,000 tons of pure nitrogen, and it is estimated that she will produce 320,000 tons during the coming season. It was pointed out, however, that there is every likelihood that in the course of the next ten years production will outrun consumption, and probably the mere possibility of synthetic output on a large scale will tend to bring down nitrogen prices to a lower level.

The Quarterly Shipbuilding Returns.

THE shipbuilding returns for the fourth quarter of last year issued this week by Lloyd's Register are of more than usual interest, for they clearly indicate in an indisputable way the beginning of the revival in the industry, which became apparent from general reports during the period in question. It is true that the total gross tonnage—1,468,599 tons—now under construction in this country is less by about 148,000 tons than that in hand at the end of the third quarter and by as much as 1,172,000 tons than that under construction a year ago. Nevertheless, the fact that a revival has set in is indicated not so much by these figures as by those relating to the construction begun during the quarter. Under this heading we find a total of seventy-eight vessels and 231,187 gross tons. A year ago the corresponding tonnage figure was only 55,290. The first quarter of 1922 saw a slight reduction in this figure, while at the end of the second quarter the lowest ebb had been reached with 38,877. In the third quarter a total tonnage of about 83,000 tons was begun, so that the fourth quarter with 230,000 odd tons represents nearly four times the activity of the previous three months in the way of laying down new ships. The returns are also interesting as showing that Great Britain has resumed its former predominance as a shipbuilding and shipowning country. Of the total tonnage in hand in this country at the present moment, over 76 per cent. is for British owners, while of the total under construction in the world, the amount being built in Great Britain is just about 49½ per cent. The most active country abroad is Germany, with 416,081 gross tons—about 28 per cent. of Great Britain's figure—under construction. The United States has now sunk to sixth place as a shipbuilding country, being exceeded in order by Great Britain, Germany, Italy, France and Holland. All the above figures for the work in hand, as distinct from the work begun during the quarter, include vessels on which activity has been suspended. In this respect, Great Britain's figure amounts to about 348,000 tons, while for the rest of the world it is about 216,000 tons, the country most affected being Italy. In spite of recent allegations regarding the inefficiency of the Clyde shipyard workers, it is interesting to note that the total tonnage being constructed on the banks of that river exceeds that for any other shipbuilding district, surpassing by some 40,000 tons the combined total for Hartlepool, Middlesbrough, Stockton, Whitby, Newcastle and Sunderland.

CALENDARS, DIARIES, &c.

AITON AND CO., Limited, Derby.—An attractive wall calendar with a very fine reproduction of a scene near Sheringham.

A. M. PEEBLES AND SON, Limited, 151, Queen Victoria-street, E.C. 4.—An engagement desk pad, with one week to a page.

W. V. BOWATER AND SONS, Limited, 159, Queen Victoria-street, E.C. 4.—Very neat desk calendar in polished frame with monthly cards.

BRITISH THOMSON-HOUSTON COMPANY, Limited, Rugby.—The B.T.H. pocket diary for 1923. This is produced in a very attractive manner.

D.P. BATTERY COMPANY, Limited, Bakewell, Derbyshire.—A panoramic view of the works at Bakewell, with monthly tear-off sheets.

HEATLY AND GRESHAM, Limited.—A large wall calendar with monthly tear-off sheets. A picture of a girl's head and shoulders is reproduced in colours.

HASLAM AND STRETTON (ENGINEERING AND MOTOR UTILITIES), Limited.—Wall calendar with monthly tear-off sheets. A very pretty picture entitled "Eva" is reproduced in colours.

W. H. WILLCOX AND CO., Limited, 38, Southwark-street, S.E. 1.—Wall calendar with monthly tear-off sheets. Many of this firm's specialities are reproduced on each sheet.

J. MARTIN BLAIR, Amberley House, Norfolk-street, W.C. 2.—A copy of the Heemaf Company's diary, Hengelo, Holland, for which firm Mr. Martin Blair is the British representative.

THE BRIGHTSIDE FOUNDRY AND ENGINEERING COMPANY, Limited, Sheffield.—Most original calendar with monthly tear-off sheets. A miner *en route* to Klondyke sits before a glowing brazier.

HOLLINGS AND GUEST, Limited, Thimble Mill-lane, Birmingham.—Wall calendar with monthly tear-off sheets. A view of one of the erecting shops, taken from a 20-ton overhead electric travelling crane, is reproduced.

WESTINGHOUSE ELECTRIC INTERNATIONAL COMPANY, 2, Norfolk-street, Strand, W.C. 2.—A wall calendar with monthly tear-off sheets. A large coloured picture of a lady's head and shoulders has been reproduced and is given the title of "Moonlight Memories."

Railway Matters.

THE interesting announcement is made that Sir Sam Fay has been appointed a director of Beyer, Peacock and Co., Limited, and as Sir Vincent Caillard has retired from the chairmanship, but still remains a director, Sir Sam has been made the chairman.

THE Australian Federated Union of Locomotive Enginemen is anxious that legislation be passed for official inquiries into railway accidents. The railways there are, it will be remembered, State owned, and any such inquiries would thus be equivalent to a department investigating its own administration.

As the 3.40 p.m. Portpatrick and Wigtownshire Joint Committee's train from Stranraer to Dumfries was running on Thursday, the 28th ultimo, between Newton Stewart and Palmure a fish wagon was derailed when passing over the river Cree viaduct. Other similar vans were derailed, but there was no injury to passengers.

THE Great Western Railway Company is about to replace the existing station at Aberystwyth by one with greater conveniences for the public and the company's own requirements. Portions of the former Cambrian line are to be doubled, and this will allow for the early morning and late evening trains to be improved, and for a better service with London.

AT a general meeting of the Institution of Railway Signal Engineers on the 3rd instant, the President, Mr. W. C. Acfield, alluded to the great change that had come to the railways by grouping, and said he was sure that the companies would find no servants more loyal or more responsive to the necessities of the times than the members of that Institution.

IT is officially announced that terms have been arranged for the absorption of the Humber Commercial Railway and Dock Company—usually known as Immingham Docks—by the London and North-Eastern Railway, and of the Stratford-on-Avon and Midland Junction Railway by the London, Midland and Scottish Railway. It is believed that the Caledonian has agreed to amalgamate with the latter. The appointment of Mr. Donald A. Matheson, its general manager, to be the deputy general manager for Scotland, of the amalgamated company supports this belief.

THE general manager of the Great Western Railway Company, Mr. F. J. C. Pole, has issued a very commendable New Year message to its staff. We would that we had space to give some extracts therefrom. Its tenor may, however, be judged from the following:—"The future of the (Great Western) Railway is largely in the hands of the staff. The company cannot succeed without the prosperity of the staff and *vice versâ*. It is essential to the betterment of the employees that the business in which they are concerned shall be prosperous. Every employee is a real factor in the welfare of the Great Western Railway."

THE Ministry of Transport statistics for October, just issued as a Stationery Office publication, show that, compared with October, 1921, there was a reduction of 4.6 per cent. in the number of passenger journeys, of 12.5 per cent. in those at full fare, and of 3.6 per cent. in the number of workmen. Journeys at cheap fares increased by 62.1 per cent. We notice, though, that despite the decrease of 4.6 per cent. in the total number of journeys, and of 10.2 per cent. in the receipts, there was an increase of 5 per cent. in the passenger train mileage, which, once again, we put down to the revived competition of the companies in anticipation of grouping.

A REDUCTION of 3s. 6d. per week should have been made in the pay of the Irish railwaymen as from Sunday last, but as the men threatened were it made, to strike, the Free State Government intervened as regards the lines in Southern Ireland, and said it would take over and guarantee the net receipts of those companies which could not carry on. The Great Northern, Midland, Great Western, and Dublin and South-Eastern will continue to manage their own lines, but the Great Southern and Western and the remainder of the lines pass under Government control. At a meeting between representatives of the companies and men of the railways in Northern Ireland it was agreed that present conditions remain for two months, during which period conciliation boards are to be set up.

IN view of the resumption on the 19th instant of the discussions between representatives of the companies and of the men as to modifications in the payments for Sunday and night duty and of the guaranteed week, the following New Year message from Mr. J. H. Thomas, which appeared in the *Railway Review* last week, is instructive:—"The year 1923 finds us in the midst of important wage negotiations, which will demand great tact and diplomacy on the part of the leaders and the undivided support and confidence of the rank and file. Merely our own sectional interests as railwaymen must not be allowed to become the sole and guiding principle of our organisation. That we have economic interests to defend, that we have duties and obligations to our wives and children, that we have the right to resist any attempt to drive us back to pre-war conditions, none can deny. But still we must always endeavour to appreciate our duty to the general public."

IN this column on December 15th we quoted the South Wales Coalowners' Association as saying that the reductions in coal rates made on December 1st had followed a very substantial increase in the volume of coal traffic, and that it was erroneous to assume that in conceding these reductions the railway companies were making substantial sacrifices in revenue. Our attention has now been drawn to the fact that the Ministry of Transport figures for August and September also showed that the increase in tonnage was made in August by an increase of 5.13 per cent. in freight engine mileage, and in September of 8.23 per cent., which were accompanied by a decrease of 26.09 per cent. in August, and of 20.55 per cent. in September in the receipts per ton. Since then the October figures have become available. These show an increase in tonnage of 28.66 per cent., an increase in goods engine mileage of 10.45 per cent., and a decrease of 14.97 per cent. in receipts per ton.

Notes and Memoranda.

INFORMATION has been published recently of various types of motor-driven road rollers produced in Great Britain. According to *Indian and Eastern Motors*, there has been some difficulty in fitting certain types with the scarifier which is used for tearing up roadways preliminary to relaying. These difficulties are got over in a special form of motor road roller designed by a British firm to utilise the scarifier when required. The frame is very strongly constructed to stand severe stresses, and the engine is so designed and geared that it gives ample scarifying power when going at the slow speed of 2¼ miles per hour. Variations in the load due to scarifying are dealt with automatically by the governor of the engine, so that the driver may concentrate his attention on the scarifying alone. Tests made with a 10-ton machine show that it operates more satisfactorily than does a steam road roller.

EXPERIMENTS are being carried out in Ceylon by the Colombo municipality on the use of rubber as a road-surface dressing. The dressing, which is the invention of a Ceylon rubber planter, is now being used on a portion of Darley-road, which is one of the busiest thoroughfares in Colombo. The solution was first tried on a road of the Devitural rubber estate, where it has been in use for the past thirteen months. The present test, according to the *British Trade Journal*, is the hardest to which the new solution has been put. The solution is made from pure bark and scrap rubber. The method of laying is similar to that employed with tar and asphalt preparations, the rubber being heated, and then spread on the road with brooms. Fine gravel is then sprinkled over the solution and a steam roller binds the two. It is claimed that though the cost of the rubber surface is higher than tar, it is found to last twice as long.

THE power plant at Hirschfelde, near Zittau, Saxony, is starting up a third large turbine, which will increase the capacity of the plant to 85,500 kilowatts. This plant is now supplying the greater part of Eastern Saxony and Western Silesia with electricity, and is also supplying the city of Dresden with very considerable quantities by means of a 100,000-volt transmission system. In 1921 the three largest power plants of the Saxon district of Niederlausitz were connected with the power plant at Hirschfelde. The high-tension system thereby established, connecting Hirschfelde, Dresden, Lauta, Spremberg, Berlin, Zcheornewitz and Leipzig, already has a length of 525 kiloms. Recently the 100,000-volt system covering Dresden, Chemnitz, Silberstrasse and Herlasgrün has been tested, so that the power plants at Hirschfelde and Lauta will be in a position to supply electricity to the distant Saxon districts of Erzgebirge and Vogtland.

WRITING in the *Electrical World*, Mr. George B. Leland states that the effect of operating an alternating-current system at low power factor is now receiving some of the attention from operating engineers that it should have had in the past. Many operating engineers even to-day do not realise the magnitude of the losses on the city distribution lines due to operating them at the generally prevailing power factors of from 50 per cent. to 70 per cent. One of the easiest ways to make a quick estimate of the losses for a line which is built is to calculate the power losses at 100 per cent. power factor as follows:—Current squared times the ohmic resistance of total length of all wires in the circuit (neglecting capacity and skin effects, &c.) gives the watts loss at unity power factor. The losses at any lower power factor can then be determined by multiplying the loss at 100 per cent. power factor by the square of the secant of the angle corresponding to the power factor of the circuit. This method of making a quick estimate of the increased losses due to low power factor has been used by Mr. Leland for a number of years, and has proved to be the means of saving a considerable amount of time.

A FEW years ago some Canadian research workers in the Canadian Department for Mines created considerable interest by putting forward a proposal to use cobalt as a metal for electro-plating in the place of nickel. The results of these researches showed that cobalt could be deposited on brass, iron, steel, copper, tin, German silver, lead and Britannia metal, and that the deposits were firm, adherent, hard and uniform, and could be readily polished to a satisfactorily finished surface. The cobalt deposited was harder than the nickel and the speed of deposition considerably greater. It was also claimed that its resistance to corrosion was definitely superior to that of nickel, and that the deposits stood satisfactorily all the usual bending, hammering and burnishing tests. The actual weight of cobalt required for a good coating was stated to be about a quarter that of nickel. These claims have not, apparently, been entirely substantiated in practice, but it is possible to electro-plate with cobalt quite satisfactorily and very rapidly. It is considered unlikely that cobalt will ever attain the industrial importance of its sister element nickel, but it has a peculiar interest of its own, and exercises considerable fascination upon those who work with it.

THE United States Air Service has set itself the task of putting the navigation of the air on as trustworthy a basis as that of water, and as part of its programme has asked the Bureau of Standards to investigate the possibilities of the earth inductor type of compass. As a result, a form of instrument has been devised which has proved more satisfactory than any previously in use in the Air Service. A memoir describing the instrument was presented in 1921 to the American Philosophical Society by Messrs. P. R. Heyl and L. J. Briggs, and was awarded the Magellanic premium. It is now reproduced in Part I. of Vol. 41 of the "Proceedings" of the Society. An armature driven about a vertical axis by a cup propeller has four carbon brushes set at right angles to each other in contact with its commutator, and capable of being set so that when the aeroplane is flying in a fixed direction, one pair of brushes gives a maximum and the other pair zero electro-motive force. The two pairs of brushes are connected to four equally spaced points of a closed electric circuit and a pointer galvanometer connected to two points opposite each other on the circuit. The diameter for which the galvanometer gives zero deflection is determined by the course of the aeroplane.

Miscellanea.

A MEETING will be held at the Institution of Mechanical Engineers, Storey's-gate, St. James's Park, Westminster, at 6 p.m. to-day, Friday, January 12th, to consider the formation of a Society of Whitworth Scholars and Exhibitioners. All Whitworth scholars and exhibitioners are cordially invited to be present.

FOUR British and Egyptian experts are leaving Cairo on the 16th inst. for Lake Albert Nyanza to investigate the possibilities of constructing a reservoir. Similar investigations have already been carried out at Lake Tana in Abyssinia, and it is understood that a favourable report is being prepared.

WITH a view to developing the membership of the Institute overseas, the Council of the Institute of Metals has just appointed a British Empire Committee, on which the Overseas Dominions are represented by distinguished metallurgists in London possessing an intimate knowledge of overseas conditions. A local section of the Institute of Metals has just been formed in Swansea, a happy sequel to the very successful meeting of the Institute that was held there in September, 1922. Thus the Institute now has sections in Birmingham, London, Newcastle-on-Tyne, Glasgow, Sheffield, and Swansea.

IT is reported that arrangements have been made by the Birmingham Chamber of Commerce, in conjunction with the British Cast Iron Research Association, to hold another International Foundry Trades' Exhibition at Birmingham in the early summer of 1924. It will be remembered that the exhibition of 1922 was the first of its kind in this country, and was an exceptional success. Steps will be taken to ensure a greater international representation at the 1924 exhibition, and arrangements will be made to increase the schedule of the foundry employees' competitions, which were so very successful.

THE State of Victoria was one of the first to recognise the importance of a good and cheap supply of power by setting up an Electricity Commission to control the generation and supply of electrical energy, and to investigate existing sources of power. These powers have since been greatly enlarged by Act of Parliament, and at present the commission possesses the right to generate and supply electricity in bulk, and in some cases in retail for power and lighting purposes. These extended powers are not viewed with much favour in local municipal circles, and strong opposition is being offered to the incursion of the commission into the business of retail supply.

LECTURING on "Wireless and Aircraft" before the Chelmsford Engineering Society, Captain P. P. Eckersley emphasised the importance of communication between aircraft and the ground and also between different machines. Quite recently a machine at Croydon lost one of the wheels from its under-carriage on leaving the ground. The pilot was warned of this by wireless and was able to make a good landing on his one remaining wheel by tilting his machine. For communication with aircraft the telephone was used rather than Morse code, mainly because the pilot had plenty to think about without having to translate Morse at the same time. The pilot had the receivers close to his ears inside his helmet, and this was found to exclude the noise of his machine quite effectively.

JAPAN'S export trade is advancing, and her trade with Malaya is a revelation of what she is capable of doing. On the other hand, she is in need of certain imported articles of various kinds, such as cotton machinery and electrical equipment. In these lines British merchants will find good openings The one great drawback the British merchant has to face is either his inability or disinclination to appoint agents or to send representatives out who are qualified to handle the goods they deal in. The appointment of experts would avoid such cases as one which was recently brought to notice, in which a building was erected to house certain machinery and then found to be too small. Such occurrences result in the loss of orders, even although the Japanese are not unmindful of the high class of goods that come from Great Britain.

THE Norwegian Radio Company, the Norwegian Marconi Company, and the Norske Telegrambureau have applied jointly to the Government for a concession regarding the establishment of wireless telephone transmitting stations and receiving apparatus in Norway. It is the intention of these three companies to form a broadcasting company which will immediately take steps to establish the necessary sending stations, first at Christiania, then at Bergen and Trondhjem. These sending stations, each with a radius of 150 kiloms., will have for their primary object the transmission of concerts, &c. In connection with them the companies have suggested that the Government should build a larger station at Christiania for the broadcasting of news, weather and financial intelligence, throughout the whole of Norway south of Trondhjem, while the North Cape will be reached by wireless telegraph.

FURTHER consideration has been given by the Commissioners to the question raised during 1921 by the British Electrical Development Association as to the limitations imposed upon authorised undertakers by the existing statutory provisions governing the methods by which consumers may be charged for electricity. The Association advocated the need for greater flexibility, so that undertakers could be in a position to frame tariff systems suitable for the varied demands on an undertaking and for encouraging the wider use of electricity for domestic purposes. The Commissioners have been furnished with data showing the practical results accruing from the operation of present methods of charge, particularly in the case of smaller electricity undertakings, and also with information as to the extent to which various authorised undertakers had been able, within the limits of their existing powers, to bring into operation multi-part tariffs by agreement with consumers. After full consideration of the various aspects of this question from the point view of undertakers and consumers alike, the Commissioners came to the conclusion that in the interests of the further development of electricity supply to meet the various classes of demand now arising, a case had been made out for the amendment of the legislative provision which had hitherto presented an obstacle to the general adoption of multi-part tariff systems of charge.

MALLET LOCOMOTIVE FOR CHINA

THE AMERICAN LOCOMOTIVE COMPANY, NEW YORK, ENGINEERS

(*For description see page 34*)

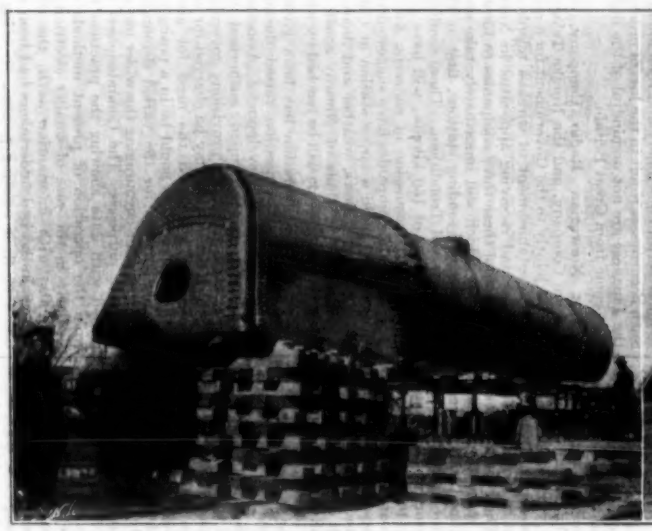


FIG. 1—BOILER JACKED OFF TRANSPORT TRUCK

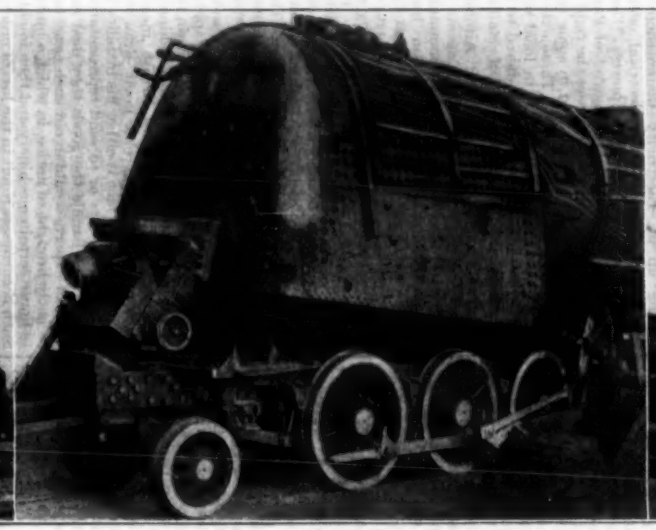


FIG. 2—FIREBOX AND MECHANICAL STOKER

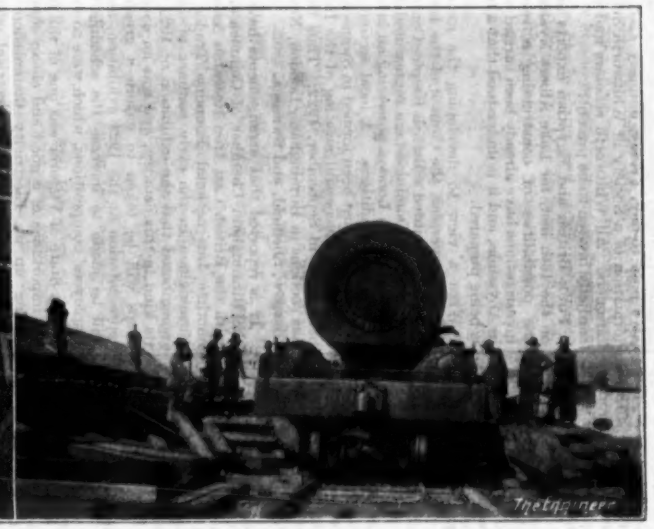


FIG. 3—BOILER LOWERED INTO PLACE

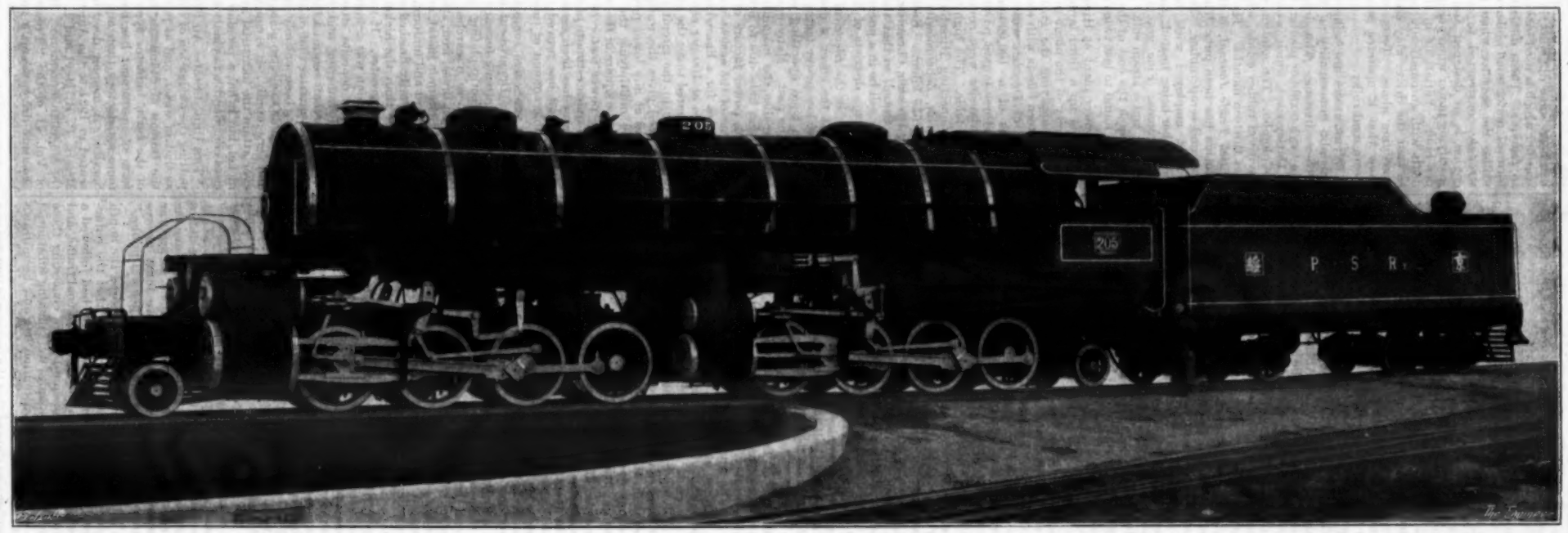


FIG. 4—MALLET LOCOMOTIVE FOR THE NANKOU PASS SECTION OF THE PEKING-SUIYUAN RAILWAY

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THE ENGINEER.

JANUARY 12, 1923.

Chinese Students in Britain.

ALMOST before the ink was dry on the Treaty which settled China's liability to the various Powers which participated in the suppression of the Boxer Rebellion, the United States of America gave out that a third of the indemnity allotted to them would be spent on promoting Sino-American interests, and more particularly on the technical education of Chinese students in the United States. That was rather more than twenty years ago, and at the time certain authorities on matters Chinese strongly advocated that the British Government should adopt a similar policy. Its soundness in the case of America has been proved over and over again in the course of the years that have elapsed since the Boxer Rebellion by the increase of American trade with the Celestial Republic. Hundreds of Chinese students have been transformed in America into doctors, lawyers, scientists, economists, architects, merchants, political agitators and other professional and business men, and especially has America set herself to the training of the Chinese as professional and industrial engineers. All these students have absorbed the American method and become imbued with American ideas, and will in their future careers naturally look first to America to supply their requirements. And now, after many Chinese students have been returned from America to China as finished business men, the British Government has decided to devote the unliquidated balance of its own Boxer Indemnity, approximately £10,000,000, to precisely the same purpose as the Americans. Thus, a sum of £400,000 is to be expended annually for twenty-three years mainly on the education of Chinese according to British methods. This is a cause for great congratulation, because, although we have let all these valuable years slip by, we are glad to see that the Government seems prepared to do something towards repairing the oversight. Although the United States were alone in utilising a portion of their indemnity for this purpose, other countries have been fully alive to the importance of encouraging Chinese students. Thus, during the many years which intervened between the Boxer Rebellion and the European War, Germany was not only giving a free technical education to large numbers of carefully selected Chinese students, but some of the big engineering firms in Germany were spending as much as £1000 on the education of an individual Chinese in Germany and paying him, during his four or five years' training, a good wage into the bargain. Many of the contracts that have gone to the United States and to Germany have done so as the result of this policy of encouraging the Chinese student.

From time to time the Chinese Government has on its own initiative gone to considerable expense in sending over to various foreign countries selected students to acquire technical knowledge, and Britain has had her share of them, as also have France, Germany, Belgium, America, Italy and Japan. But while these officially adopted students came to England mainly to be trained in naval matters, to Germany for military training and to France for legal training, it is significant to note that those sent to America were all to be trained in industrial matters. But the number of students sent out under purely Chinese auspices has been very limited, and a mere fraction of those imported into various foreign countries which have relieved the Chinese of all trouble and expense in connection with their training. Fortunately, during all these years when the British Government was asleep as to the necessity for encouraging business relations between Britain and China, private enterprise was doing something to minimise the neglect. Thus, the establishment of the Hong Kong University, which now is a very important institution, and has grown under purely British auspices from small beginnings, has done a very great deal for the Anglicising of the Chinese engineering student. But a University training, however good it may be, is, after all, purely academical, and it is only by bringing the Chinese into our works in Britain that they can be made to absorb thoroughly the atmosphere and practice of the British system. Just before the war an endeavour was made to provide a means, irrespective of Government assistance, of securing a large number of the right type of Chinese student for this country, more particularly in our engineering works. A strong committee was formed, composed mainly of British manufacturing engineers and acted under the advice of Sir Walter Hillier, formerly Adviser to the Chinese Government, and others who had had a life-long experience of the Chinese character. This movement had the sympathetic approval of the British Foreign Office and the Chinese Legation in London. An appeal was made to British manufacturers to offer all possible facilities—provided that the committee could obtain for them the right class of men—for taking Chinese students into their works. A large number of firms at once volunteered to accept such students without any question of premium, and even to pay them a specific wage during their period of apprenticeship. Although the conditions that the committee were able to offer to the Chinese were by no means as liberal as those that could be obtained either in America or in some other countries, the effect of this step was to bring a certain number of students over, and in every case they were well placed and proved satisfactory to the firms who took them. The war, however, put an end to this promising venture, and it has never been resuscitated since. Now, however, that there is a certainty, not only of Government co-operation, but of substantial financial support, there is no reason whatever why the importation of Chinese students for purposes of engineering training should not develop into an important and very valuable enterprise. But it is precisely because the difficulties of finance are now to be removed that extreme care must be taken in the manner in which these funds are to be expended. When anything is given free there are always plenty of applicants, but for the Chinese student to do justice to himself and at the same time to be in a position to improve the trade relations between Britain and China later on, it is essential that he should come of the right people and himself be a desirable person. This requirement necessitates a competent organisation in China for purposes of selection, and it fortunately exists in nucleus in the shape of the British official Trade Commissioners, the Hong Kong University and some of the other scholastic establishments which are partially, if not entirely, under British tutelage.

There is another side to this question which must not be overlooked. It is not merely necessary for us to know that we are getting the right type of student, but it is necessary that we should be able to convince the parents or guardians of such students in China that these young men will be properly looked after when they get to this country. Thus, there should be something in the nature of a committee under Government auspices whose business it would be to receive the students, to arrange for their passages and for their remittances, if any, from China, to place them in the various works and ascertain, and to some extent to determine and to watch, the conditions under which they would be employed, and to repatriate or shift them if they were unsatisfactory. All these things were provided for under the tentative scheme to which we have referred above, and could be used

for the larger project. While the "Chinese Quarter" is a by-word in every community which is unfortunate enough to possess one, it has long been proved by those who have had experience of the better class of Chinese student in this country, and much more fully proved in other countries where larger numbers have been brought over, that in nearly every case young educated Chinese make admirable citizens from every point of view—but they must be adequately looked after when here. It is this type of Chinese that we require in our engineering works, and it will be the duty of our engineering firms to encourage them and make arrangements for their proper accommodation. What must be avoided at any cost is the indiscriminate importation of all sorts and conditions of Chinese, and especially of those who have not had a certain grounding in technicalities and English before they are sent over. Thus, the selection as a rule should be made from students who have already been through a course at the Hong Kong University or some other competent technical school in the Far East.

Temperature Control.

AT the present moment, when the war-time realisation of the importance of applying science to industry has not yet quite died away, one would think that it was little better than flogging a dead horse to insist upon the importance of scientific temperature control in all industrial processes, and particularly in those of a metallurgical nature. It would seem, however, that this is by no means the case, since there are numerous shops—and many important ones among them—where the human eye is still regarded as the best pyrometer, and where the roughest and crudest methods are employed for the purpose of aiding it. None the less, those responsible for such shops pay lip service to the value of science in industry. Perhaps they labour under the belief that scientific research may some day furnish them with new discoveries that shall be a royal road to new success—discoveries whereby antiquated plant and methods may, without improvement, bring forth marvellously profitable results. Such a belief is, of course, destined to disappointment. Not only this, but it is safe to say that those who fail to make use of what scientific research has already provided are not in the least degree likely to profit by future discoveries. The real secret of success in the application of science to industry—and success in that direction is fundamental to industrial success in general, in an ever-increasing degree—lies in the active and intelligent application of new knowledge as soon as it becomes available. The plea is sometimes put forward that new scientific knowledge is not readily available to those engaged in industry. While there may be some difficulties of this sort, they are generally exaggerated and frequently advanced only by those who really seek an excuse for inaction. No such excuse can possibly apply in regard to means of measuring temperature. Instruments for that purpose are well known and freely advertised in the technical Press: they are installed literally in hundreds in the more progressive works throughout this country and to a still greater extent in other countries, and yet we find British industries definitely handicapped by the failure to adopt these scientific aids to sound and reliable production.

As an illustration of what still happens in some British works, we may quote a story told by the then Director of the National Physical Laboratory of a war-time incident in connection with magnet needles. A well-known firm was in difficulties, its needles being of excessively variable quality. Advice as to hardening temperatures was given, and in reply it submitted a series of specimens described as having been hardened at temperatures successively higher by 50 deg. Cent. Tests showed that magnetically these needles did not follow the order of hardness to be expected from the temperatures stated, and on inquiry it was found that the firm in question did not possess a pyrometer other than the human eye, and that this eye—in the head of its most skilled workman—had been unable to secure even a correct *order* of temperatures. The whole of the difficulty vanished as soon as proper pyrometers were employed. Nor is this an isolated instance. At the present time there are probably few shops in which springs are hardened and tempered in which it would be possible to state the true temperatures employed, and the resulting product shows precisely that degree of variability, and at times unreliability, which is to be anticipated. In America, on the other hand, pyrometric control of spring heat-treatment—to take the same example—is carried out most thoroughly. In some of the larger works, the pyrometric system is centralised and temperatures from a number of furnaces are read in a pyrometer office or station, from which guiding signals are transmitted, by means of coloured electric lights, to the men working the furnaces. Such a method of control avoids the difficulty of direct contact between furnace workmen and scientific instruments which, although comparatively robust, are still delicate as compared with a shovel or a pick-axe. Such a method also avoids the tendency on the part of some less intelligent workmen to resent the installation of instruments. Cases are, of course, known where recording pyrometers and other recording instruments appear to have been deliberately damaged by men who objected to such continuous control of their work. That is, no doubt, a real difficulty, but one which can and must be overcome by education and tact. Once men can be got to appreciate the real value of such instruments, to understand that to the honest worker they are a real aid and by no means a hindrance, and that they really save needless work and trouble, there will soon be an end of opposition. It is, however, obviously essential that conviction as to the real value of scientific control should first reach the mind of the employer or of those who control the work. Until that is achieved, a very little opposition on the part of the men, a very little technical difficulty with the instruments themselves, will suffice as an excuse to avoid or postpone this particular forward step. As we have said above, a great many of the more progressive firms have reached such realisation long ago; some of them, indeed, reached it so early in the history of pyrometry that they were willing to face the defects and difficulties of the earlier instruments for the sake of the immediate advantages to be gained. These firms have themselves helped the progress of industrial pyrometry, and now reap their reward not only in a more economical and more uniform output and an economy of fuel and materials generally, but in improved types of pyrometers, from which most of the old difficulties have been eliminated. The backward firms which have hitherto failed to install adequate means of temperature control now have these improved instruments at their disposal, and it may confidently be said that they are simply inviting difficulties in production, and loss of business to more progressive competitors, either here or abroad, whilst they fail to utilise these modern facilities.

While we thus strongly urge the use of scientific means of temperature control, and suggest that the instruments available at the present time are practical and useful, the makers of such instruments and the investigators upon whose work the design of good pyrometers is based, must also be asked to make the best possible progress. The pyrometers of to-day are very much in advance of those of ten or fifteen years ago. Half a dozen inventions and discoveries have contributed to this result, but there is still room and need for further advance. Instruments for works use are required to be sturdy in construction and thoroughly well protected against dust, and often against heat and vibration. Where thermo-couples are placed in furnaces, still better means of protection against damage, either chemical or mechanical, are required, while the materials of the couples themselves are open to much further improvement, so as to give them still greater useful life. Here, however, the steadily increasing industrial demand for reliable pyrometers is proving a strong incentive, and in that connection it is interesting to note that recent advances in the so-called "base metal" couples have come mainly from America. Competition among makers of industrial pyrometers, on the one hand, and the support and encouragement given to research workers by the Government Research Department justify the hope that further progress will not be long delayed. As a nation, we have never been far from the very van of scientific and technical progress. It is in the exploitation of our own discoveries and inventions that we tend to lag behind. At the present time, the industrial pyrometers made in England are at least as good as any that the world can show—possibly they are slightly in advance of others. What we wish to insist upon is that our manufacturers, small as well as great, should make an intelligent and adequate use of these facilities provided by science.

Textile Machinery Papers at "The Mechanicals."

IT was rather unfortunate that Mr. Walsh's paper on "Ring Spinning Machinery" was placed on the syllabus of the North-Western Branch of the Institution of Mechanical Engineers for reading in Manchester just before the Christmas season, but it could not be avoided without clashing with other meetings of technical societies in Manchester. The nearness to Christmas no doubt had an effect upon the attendance, which was not as large as could have been desired. The paper was the second of the series on textile machinery which the local Committee decided upon, and despite the criticism of the manner in which the subject was dealt with, there was a consensus of opinion that Mr. Walsh had acquitted himself very well. The main criticism was that the paper was elementary, but, as Mr. Charles Day, the chairman, pointed out, the author had compiled a paper such as was asked for by the Committee, with the object of creating more interest in textile machine design and construction amongst the members of the Institution than had hitherto existed, and in the hope that further papers, going deeper into details, would be read later. Whether success will follow on these lines remains to be seen. The experiment, at any rate, deserves to succeed, for there are many ingenious and complex pieces of mechanism in textile machinery, the action of which is almost entirely unknown to a large percentage of mechanical engineers. Ingenious as many of these devices may be, there are other conceivable means of attaining the desired ends, which will probably result from discussions amongst engineers who may approach the subjects from a different angle, such, for instance, as machine tool designers.

It was pointed out in the discussion which followed the reading of Mr. Walsh's paper that some of the most recent improvements in textile machine design had been made by persons not connected with this branch of engineering. By this, it is not implied that textile machinists are lacking either in inventive ability or in workshop organisation or methods. Rather the reverse. There is probably no branch of constructive engineering which can manufacture appliances of equal quality, and embracing so many delicate pieces of mechanism, so cheaply as the Lancashire textile machinists. Many of these work to the finest possible limits of error, and no better example of this could, probably, be cited than that of the spindle which comprises about ten different parts and has to revolve at speeds between 8500 and 10,000 revolutions per minute. This spindle has to be perfectly balanced, and the manufacture of the spindle blade alone involves some thirty-three operations. The flexible ring spindle is so accurately made that under actual conditions, carrying bobbins or paper tubes it can be run at speeds approaching 13,000 revolutions per minute and remain perfectly steady. What a beautiful piece of workmanship it is can be gathered from the fact that over 400 can be operated at a speed of 8500 revolutions per minute, with a consumption of less than 6 horse-power. What is more, these spindles will continue to run for months without attention for lubrication, and their initial cost is about 5s. each at the present time.

Literature.

Brassey's Naval and Shipping Annual, 1923. Edited by Sir ALEXANDER RICHARDSON and ARCHIBALD HURD. William Clowes and Sons. 25s. net.

FOR more than a generation now the appearance of "Brassey" has been an annual event of significance to the naval world, constituting as the book does an authoritative record of progress in that special sphere, and providing a fund of information as to current developments in policy, *personnel*, and material. When the present editors assumed control three years since, they decided to enlarge the traditional character of the publication by adding chapters and statistical matter relative to commercial shipping. The success of the innovation was quickly assured, and "Brassey's Naval and Shipping Annual," as it is now called, has already established itself as a work of reference indispensable to all who wish to keep in touch with the evolution of the world's merchant fleets and of sea trading in general.

The balance between the military and mercantile sections of the volume is equably maintained. The first part is devoted to a review of international naval events of the past year, prominence being given to the influence of post-war conditions on policy, organisation, strategy, and design; while the second part contains a series of weighty articles on subjects of interest to shipowners, shipbuilders, engineers, and economists. The statistical tables in each section are remarkably complete and well arranged, enabling the reader to turn up without delay whatever item of information he seeks. In going through this latest issue we have been impressed by the wide range of

subjects it covers, and not less so by the skill with which the editors have contrived to work so much material into a volume of by no means unwieldy proportions. The chapter on the British Navy, from the pen of Commander C. N. Robinson, R.N., is, as always, a comprehensive and accurate narrative of the principal Service events of the year, due regard being paid to the effect which retrenchment has had on the strength and disposition of the fleets in home and foreign waters. Foreign progress is dealt with by Mr. John Leyland, who finds that American naval policy, like our own, is at present mainly dominated by the need for economy. His conclusion that the provisions of the Washington Treaty have simplified Japan's naval problem by reinforcing her strategic situation, despite the abolition of so many of her capital ships, is unquestionably sound. The comparative strength of the world's navies, as affected by the Treaty, is analysed and tabulated in a chapter by the Editors.

In this naval section there are two papers of such extraordinary interest that we can only regret the exigencies of space which preclude us from doing full justice to them. The first, by Sir George Thurston, is an attempt to indicate the best methods of harmonising the restrictions of the Washington agreement in regard to dimensions and armament with present tactical desiderata in the case of capital ships and cruisers. No one is better qualified to discuss this subject than the distinguished naval architect who, in the Editors' words, "has exhibited much originality and courage in interpreting the requirements of the naval officer." After observing that the Washington compact imposes an artificial check on the progress of scientific achievement, Sir George sets forth the paramount features of the capital ship and demonstrates the impossibility of combining them all within a hull of the specified displacement of 35,000 tons. He then suggests alternative designs—one embodying maximum gun power, strong protection, but moderate speed; a second, in which both gun power and protection are partly sacrificed to obtain high speed; and a third, in which the maximum degree of artillery power is associated with high speed at the cost of protection. We are inclined to regard the first design as an intelligent anticipation of our two new battleships. It provides for a length of 700ft., a breadth of 104ft., 28ft. 6in. draught, and a displacement of 36,000 tons, inclusive of 1000 tons of fuel for trial condition. The machinery of 55,000 shaft horse-power would be equivalent to a speed of 24 knots. As main armament there would be mounted nine 16in. 45-calibre guns in triple turrets, all three being placed forward of the machinery spaces; the secondary battery to consist of twelve 5.5in. or 6in. guns and the usual anti-aircraft pieces. Torpedo equipment would be omitted, the late war having shown the uselessness of such armament to capital ships, and it appears to Sir George "that the fitting of torpedo equipment to either battleships or battle-cruisers is an entirely useless and expensive luxury, useless in the fullest sense of the word, and costly not only in sterling, but in the occupation of valuable underwater space." A precisely similar view was expressed by THE ENGINEER in a leading article published nearly seven years ago. Armour protection in the design under consideration would consist of 15in., 14in., 13in., 7in., and 5in. plating on the sides and decks, and 16in. to 10in. on the gun positions. Broadly speaking, all these features would, we believe, have been embodied in the four battle-cruisers of the cancelled 1921 programme, except that a much higher speed was aimed at in those ships, the displacement of which would have exceeded the Treaty limit by some 12,000 tons. Of the two alternative designs for a 35,000-ton ship, the first provides for a speed of 30 knots, a main armament of six 16in. guns, and somewhat lighter protection; while, in the second, nine 16in. guns and a speed of 30 knots are retained by thinning the armour belt to 8in. This latter project is of interest, not because it is ever likely to be adopted, but as illustrating the result to be expected when two main features are maintained intact at the expense of the third. Finally, Sir George proposes an "experimental" type of capital ship, displacing 35,000 tons, armed with three 16in. and six 7.5in. or 8in. guns, having a speed above 30 knots, and complete armour and sub-surface protection. She would transport aircraft for her own defence and for attacking enemy ships, a large area of deck space being left free for aviation purposes by suppressing funnels and carrying furnace smoke overboard through ducts swept by water from the circulating pumps. This design is ingenious enough, but we doubt if it would find favour in naval circles. Fighting power seems unduly subordinated to speed and aviation equipment, and a mixed battery of 16in. and 8in. guns would tend to complicate fire control. As regards light cruiser design, Sir George Thurston considers it possible, without going beyond the Treaty limit of 10,000 tons, to build a vessel of not less than 34 knots speed, with adequate protection, and a battery of eight 7.5in. or 8in. guns twin-mounted *en barbette* on the centre line. This is a most timely and suggestive contribution on a subject of prime importance which has not hitherto been dealt with in an authoritative manner.

The second article to which we refer above is an account of the history and services of the Royal Corps of Naval Constructors, by its present distinguished head, Sir Eustace H. T. d'Eyncourt. The origin of the Corps, its development, present organisation, the nature of its duties, and its wonderful record of work during the late war are fully described. Within the period from August, 1914, to the Armistice, no less than 842 vessels, with an approximate displacement of 1,602,000 were added to the Royal Navy, of which number all but eighty-nine were laid down after the outbreak of hostilities. The execution of this enormous programme threw a heavy burden on the Royal Corps of Constructors, for not only had building operations to be speeded up, but many new designs of novel type had to be evolved to meet requirements suggested by war experience. Members of the Royal Corps have every reason to be proud of an achievement which contributed so much to the winning of the war, and, at the same time, enhanced the prestige of British naval architecture and engineering. In a chapter on "The Material Resources of Naval Defence," the Editors survey existing facilities in this country for the production of warships, their armament, and equipment, and pertinently inquire what is to become of these costly plants which have been specially erected for the manufacture of heavy armour plate and ordnance, now that the future demand for new construction has been so radically curtailed by the agreement reached at Washington. There are several other papers in this section which deserve careful study, such as "Cruisers and Naval Warfare," by Rear-Admiral W. H. D'Oyley; "Sea Power and Air Power," by Commander C. D. Burney, R.N., whose enthusiasm for the military possibilities of the airship is undiminished; "The Strategic Problem of the Pacific," by Mr. A. Colbeck; and "The Principles of Imperial Naval Defence," by Commander H. Rundle, R.N. There is, indeed, no leading aspect of the naval problem of the immediate future which is not dealt with as fully as its importance merits.

Equal thoroughness has been practised in the compilation of the merchant shipping section, which forms an invaluable record of progress in the world's carrying fleets during the fourth year of peace. The severe depression under which the shipping industry has laboured for some time past still continues, but in the opinion of Sir Westcott S. Abell, of Lloyd's Registry, the end of the slump is at last in sight, though the process of recuperation bids fair to be long and laborious. Mr. James Richardson reviews the latest developments in marine machinery with his accustomed grasp of the subject, giving commensurate space to such important questions as the improvement of reduction gears in connection with ships' turbines, the growing rivalry between the Diesel engine and the steam reciprocator in cargo-carrying ships, auxiliary machinery, oil fuel supply, and the metallurgical problems on the solution of which further progress in propelling machinery mainly depends. An entirely new feature, so far as "Brassey" is concerned, is the inclusion of many pages of silhouette drawings of the principal men-of-war and merchant vessels of the world. These appear to have been drawn with great care, and should render the identification of each type no difficult matter under good conditions of visibility. In conclusion, we need only say that the 1923 edition of this famous year book seems to us in every respect a distinct improvement on previous issues, and a model of what such a publication should be.

The Subject Index to Periodicals, 1917-1919. K. Science and Technology. Issued by the Library Association, London. 1922. Price £1 15s. net.

THE appearance of the third issue of "The Subject Index to Periodicals (Science and Technology)" is a welcome event. America has had an index of this kind for the last 45 years. It was originally known as "The Descriptive Index of Current Engineering Literature," and is now conducted by the combined engineering societies of the United States, under the name of "The Engineering Index." From the point of view of Great Britain it has its faults. Inevitably it gives more attention to American papers than to British, and it does some injustice, in consequence, to the periodical, scientific and technical literature of this country. There was, therefore, real need for the publication of a British index, and we are heartily glad that the Library Association saw its way to take up what must prove a very hard task. The volume before us, the third to appear, covers only the three years 1917, 1918 and 1919, but it runs to no less than 228 large quarto pages, and contains 15,000 entries drawn from 400 periodicals. Such figures give some idea of the magnitude and thoroughness of the work.

A fact which immediately strikes the eye of the reviewer is that there is no attempt at classification. That must seem strange to those whose whole philosophy is summed up in the verb "to classify." But speaking with not a little knowledge of the matter, we express our approval of the simple, and only apparently crude, alphabetical arrangement. Odd as it may seem to have Cholera, Chows and Chrome-Steel Alloys, or Lobsters, Locks and Locomotives treading on each others heels, yet experience shows that, in the long run, classification does very little to shorten an index, and whilst it undoubtedly helps the searcher in one direction it hinders him in another. We have known a whole block of subjects in a classified index missed because the searcher did not know under what head to look for them. Finally from the compiler's point of view the straight alphabetical method is the easiest and cheapest, and it removes that ever-present difficulty under what classified heading to put doubtful subjects. Of course, cross-references must be plentiful, as they are in this volume, and it should be noted that the headings and references are standardised.

The verbal arrangement of the entries is as follows. The subject is clearly shown in black-faced type on a line by itself, sometimes followed by a sub-heading in italics. Then comes the title with its "bibliogram." For the latter close abbreviation has been avoided—a very good thing. Enough is left of the name of the journal to be quite comprehensible without reference to a glossary. The whole of each bibliogram is in type similar to that in which this review is printed. We are inclined to think it would have been convenient could italics have been used for the names of the periodicals consulted, but we are aware that the cost of production would have been increased. It not infrequently happens that the searcher knows the name of the periodical but desires to find the reference to volume and page. In such cases distinctive type facilitates a search.

There is no way of testing the importance and accuracy of a work of this kind short of using it continuously for several months. It is clearly quite impossible for every subject in every journal to be entered; a selection has, therefore, to be made, and the utility of the selection depends upon the personal feelings of the indexer. Thus some searchers will always find *lacunæ*, and the best any index of such wide scope as this can hope to achieve is service to the greatest number. Time alone can show how far that object has been attained.

One word remains to be said in conclusion. The volume is an index of all sciences and of all technology; not only of engineering and cognate subjects, and in that respect differs from the American "Engineering Index." In clearness of arrangement and size of type it easily surpasses that publication. It forms one of a series begun in 1915, which it is proposed to continue year by year. But the Library Association is not a wealthy body, and whilst with the exception of a paid editor all the work of compilation is done voluntarily, it must find it difficult to continue to publish this invaluable catalogue if the subscription list is not increased. One is tempted to wonder why the State Libraries do not share in the bearing of a burden of national importance.

We may add that the Association publishes similar class lists to many other subjects besides science and technology, and that "The Subject Index" is not run for profit.

BOOKS RECEIVED.

L'Union d'Electricité et la Centrale de Gennevilliers. By E. Mercier. Paris: Revue Industrielle, 57, Rue Pierre Charron. Price 5f. (postal union).

How to Form a Company. Fifteenth edition. By H. W. Jordan. London: Jordan and Sons, Limited, Chancery-lane, W.C. 2. Price 1s. 6d. net.

The Principle of Relativity with Applications to Physical Science. By A. N. Whitehead. Cambridge: At the University Press. Price 10s. 6d. net.

Practical Civil Engineering Simplified for the Far East. By J. R. McLeod. London: Cecil Palmer, Oakley House, Bloomsbury-street, W.C. 1. Price 7s. net.

The Marine Power Plant. By Lawrence B. Chapman. London: McGraw-Hill Publishing Company, Limited, 6 and 8, Bouverie-street, E.C. 4. Price 20s. net.

Cours complet de Mathématiques spéciales Mécanique. Tome III. By J. Haag. Paris: Gauthier-Villars et Cie, Editeurs, 55, Quai des Grands-Augustines. Price 12f.

Income Tax Simplified. By Arthur Fieldhouse. Huddersfield: A. Fieldhouse, P.O. Box A 27. London: Simpkin, Marshall and Co., Limited, E.C. 4. Price 1s. 8d. post free,

Patents for Inventions. By J. Ewart Walker and R. Bruce Foster. London: Sir Isaac Pitman and Sons. Limited, Parker-street, Kingsway, W.C. 2. Price 21s. net.

The Institution of Production Engineers. "Proceedings" of the Session, 1921–1922. Vol. I. London: Published by the Institution, 6, St. James's-square, Holland Park, W. 11.

A Second Course in Engineering Science. By P. J. Haler and A. H. Stuart. London: University Tutorial Press, Limited, High-street, New Oxford-street, W.C. Price 5s. net.

The Chemistry and Technology of Gelatin and Glue. By Robert H. Bogue. London: McGraw-Hill Publishing Company, Limited, 6 and 8, Bouverie-street, E.C. 4. Price 30s. net.

Wireless: Popular and Concise. By Lieut.-Colonel C. G. Chetwode Crawley, R.M.A., Deputy Inspector of Wireless Telegraphy, G.P.O. London: Hutchinson. Price 1s. 6d. net.

Factory Storekeeping: The Control and Storage of Materials. By H. H. Farquhar. London: McGraw-Hill Publishing Company, Limited, 6 and 8, Bouverie-street, E.C. 4. Price 12s. 6d. net.

Punjab Canal Gazetteers, Vol. I., Lower Jhelum Canal, 1920. Compiled and published under the authority of the Punjab Government. Lahore: Printed by the Superintendent, Government Printing. Price Rs. 2.12.0, or 3s. 10d.

Ministry of Munitions and Department of Scientific and Industrial Research. Technical Records of Explosives Supply, 1915–1918. *No. 9: Heat Transmission.* London: His Majesty's Stationery Office, Imperial House, Kingsway, W.C 2. Price 5s. net.

Mechanical Stoking at Sea.

IN the early part of the present year a small (1250 tons) Dutch steamer, the Bintoehan, of the Koninklyke Paketvaart Maatschappy, Amsterdam, which is equipped with a single Babcock and Wilcox marine boiler, was fitted with a mechanical stoker of the Underfeed E type—see Fig. 1. After the change from hand firing a trip was made from

FIG. 1—MECHANICAL STOKER FITTED TO MARINE BOILER

Amsterdam to Hull, then from Hull to Newcastle, and finally from Newcastle to Rotterdam. On that voyage the mechanical stoker worked extremely well, although on part of it very rough weather was encountered, and the vessel pitched and rolled badly. The results were so satisfactory that a second vessel, the Parigi, owned by the same company, was fitted, and extended trials have been carried out on both vessels on the long voyage to the Far East and subsequent trading voyages.

The Bintoehan completed her trip to the East (Dutch East Indies) with mechanical stokers in May last, and Mr. Muller, the chief engineer, reported that no hitch occurred on the whole voyage, and that the steam pressure was maintained absolutely steady, whilst the average CO_2 was 12 per cent. The uniformity of the steam pressure is regarded as the most striking feature of the installation, as with hand firing the furnaces have to be cleaned out at every watch, with a consequent reduction in steam pressure and a heavy drop in efficiency. The working conditions in the firehole were, of course, greatly improved. Mr. Muller caused the most careful observations to be made as regards the coal consumption in comparison with an exactly similar vessel to the Bintoehan, hand fired as usual, and reported that mechanical stoking resulted in 10 to 15 per cent. reduction in the coal bill, combined with a few days less on the voyage, and almost complete absence of smoke from the funnels.

The Underfeed mechanical stoker on the Bintoehan has only a very restricted combustion chamber, and accordingly before the second and exactly similar vessel, the Parigi, was equipped with mechanical stokers, the Babcock and Wilcox boiler was raised 2ft., the combustion chamber being thus considerably increased in cubic capacity, the boiler, at the same time, being fired from the back instead of the front, as illustrated in Fig. 2. This drawing, it should be noticed, shows the small combustion space before the tubes were raised. The result was a still further improvement in comparison with the Bintoehan. Thus, on the first voyage from Holland to Hull, the temperature of the exit gases on the Parigi averaged 570 deg. Fah. (300 deg. Cent.), as against 750 deg. Fah. (400 deg. Cent.) on the Bintoehan, which corresponds to about 6 per cent. difference in the efficiency, or about 8 per cent. in the coal bill. It may be stated that the Bintoehan, in the voyage to the East, consumed 480 tons of coal, a performance, as already mentioned, much better than a hand-fired ship; whereas the figures for the Parigi were only 440 tons, and more aggregate power was developed.

Mr. Muller's subsequent report of September 21st, 1922, confirms the original saving of 10 to 15 per cent. with the mechanical stoker on the Bintoehan, which results were obtained without difficulty when using Indian coal in trading voyages in the East. With very badly clinkering coal it was found that the clinkers could be removed by hand through the fire-doors without difficulty. We are informed that, in consequence of these results, the owners have decided to fit more mechanical stoker installations and to combine with them mechanical coal conveyors from the bunkers to the stoker hoppers.

The Parigi is exceptionally well equipped for a test, being provided with a boiler feed meter, CO_2 indicator, draught gauges, and a spring balance for weighing the coal. A detailed test of twenty-two hours was carried out on July 21st–22nd last on the voyage between Rotterdam and Hull in the presence of Mr. Muller and representatives of the Underfeed Stoker Company, Limited, and Babcock and Wilcox, Limited, London, the results of which are given below :—

Dimensions of boiler—		
Heating surface	216 sq. m.	$\frac{\text{H.S.}}{\text{G.S.}} = 31.8$
Grate surface (incl. side grates)	6.8 sq. m.	
Duration of test	22 hours	
Water—		
Average feed water temperature after heater	60 deg. Cent.	
Consumption of feed water during test	102,100 kilos.	
Consumption of feed water per hour	4650 kilos.	
Steam—		
Steam production during test	102,100 kilos.	
Steam production per sq. m., H.S. per hour	21.5 kilos.	
Average steam pressure	175 lb. per square inch	
Coal—		
Fired during test	11,330 kilos.	
Fired per sq. m., G.S. per hour	77.5 kilos.	
Calorific value of coal as fired	7029 calories per kilo.	
Evaporation per 1 kilo. of coal	$\frac{102,100}{11,330} = 9.01$	
Heat contents in 1 kilo. of steam	665 − 60 = 605 calories	
Efficiency of boiler	$\frac{901,605}{7029} = 77.5$ per cent.	
Average temperature difference between flue gases at chimney base and engine-room	265 deg. Cent.	
Average percentage of CO_2	11.4 per cent.	
Heat carried away in chimney gases	$\frac{0.65 \cdot 265}{11.4} = 15.2$ per cent.	

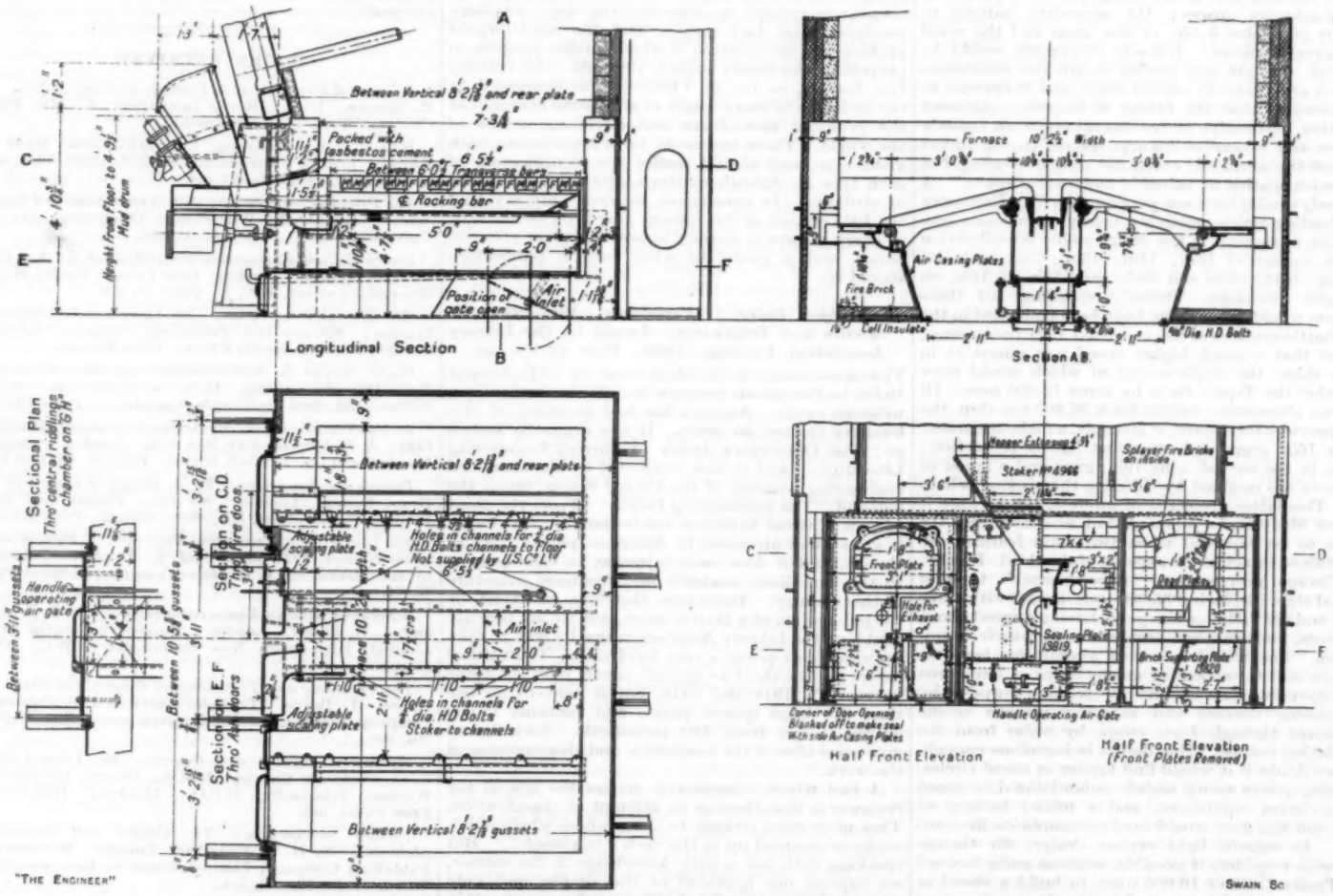

Longitudinal Section
Section A.B.
Sectional Plan
Section on C.D
Section on E.F
Half Front Elevation
Half Front Elevation (Front Plates Removed)
Between Vertical 8 2⅛" and rear plate
Packed with asbestos cement
Rocking bar
Position of gate open
Air inlet
Furnace 10' 2½" Width
Air Casing Plates
Fire Brick
Between Vertical 8 2⅛" gussets
Adjustable sealing plate
Holes in channels for 1" dia H.D. Bolts channels to Floor Not supplied by U.S.C° Ltd
Holes in channels For ⅞ dia. H.D Bolts Stoker to channels
Handle operating air gate
Front Plate
Hole for Exhaust
Brick Supporting Plate
Handle Operating Air Gate
"THE ENGINEER"
SWAIN Sc

FIG. 2—GENERAL ARRANGEMENT OF UNDERFEED STOKER FOR BABCOCK AND WILCOX MARINE BOILER

Heat balance—	
Efficiency of boiler	77.5 per cent.
Heat carried away in chimney gases	15.2 per cent.
Unaccounted for	7.3 per cent.
	100.0 per cent.

It will be noted that the results are highly satisfactory, the combustion being smokeless, the average figure for CO_2 on the combustion indicator being over 11 per cent., and the efficiency of the boiler 77.5 per cent.

A French Petrol Rail Car.

THE problem of running local lines under economical conditions has had to be taken seriously into account by the French railway companies since the Government impressed upon them the necessity of becoming self-supporting, so that they would no longer be required to rely upon the financial assistance of the State. In a general way, the local lines have never been able to pay their way, and there has been a diminution in the number of trains, while in certain cases it has been proposed to suppress the services altogether. Some new method of traction had therefore to be found, whereby it would be possible to effect considerable economies and bring down the costs to a point where they would be covered by the traffic receipts. It is also expected that the receipts will be increased by running a larger number of light trains. Obviously, an alternative to the steam locomotive is the petrol locomotive, which has the advantage of consuming fuel only when actually running, and of having very low upkeep charges, while it is ready for starting up at any moment. The difficulties so far encountered with petrol motors for railway use in France have been due in part to the running of long vehicles on two bogies, which could not be manœuvred on turntables, and a driver's cab had therefore to be arranged at each end, with the result that there was a complicated system of control that needed frequent adjustment. The real solution therefore lies in simplifying the type of vehicle.

The State Railways presented the problem to Messrs. Schneider et Cie, of Creusot, who were asked to prepare plans of a railway motor with one cab and a wheel base short enough to allow of its turning on the turntable, while it should be sufficiently powerful to haul one or two coaches. For this purpose, it was proposed to transform one of the old State second-class coaches with four compartments, of which two would be altered and rearranged to provide room for the engine and cab. The vehicle thus transformed was first tried on a line near Mantes in August last, and the results obtained were so satisfactory that it was put into service on the line between Mortaigne and Sainte-Gauburge, in the Department of the Orne. The engraving we reproduce in Fig. 1 shows an external view of the rail car, with one coach attached.

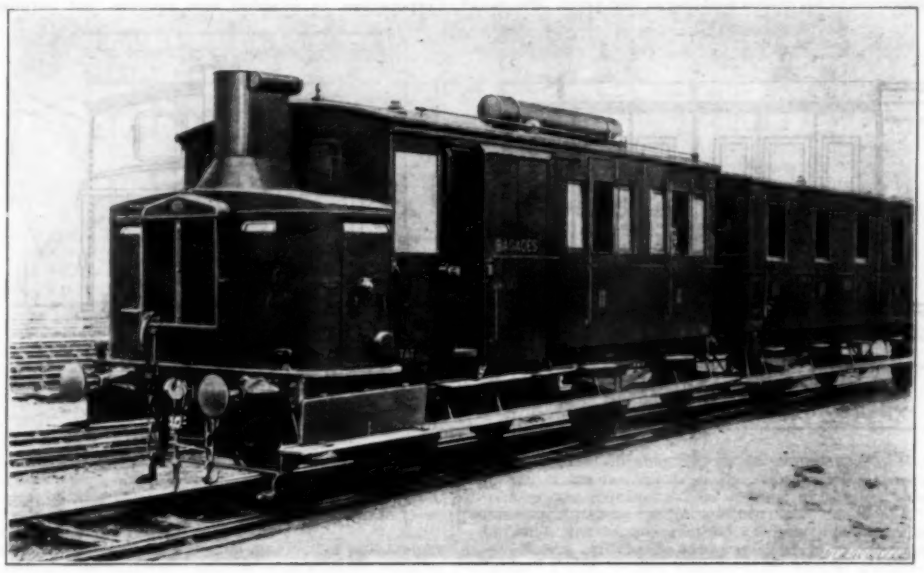


FIG. 1—62-72 HORSE-POWER FRENCH PETROL RAIL COACH

GENERAL ARRANGEMENT.

A sectional view of the engine itself is shown in Fig. 2, from which it will be noted that the design of engine has little to differentiate it from the up-to-date petrol motor which is used in motor lorry and tractor service; indeed, engines of the same design, built by Schneider et Cie., have given excellent results when used in these services. The engine is of the four-cylinder type, with a cylinder bore of 135 mm. and a piston stroke of 170 mm., and it is designed to run at speeds of from 1000 to 1200 revolutions per minute, developing 62 horse-power at the former and 72 horse-power at the latter speed. The cam shaft A is enclosed in the crank case, and is driven from the crank shaft by a pinion B, which meshes with the driven wheel C. The overhead valves D are operated by push rods in the usual manner. A special governor which is built on to the end of the cam shaft controls the engine speed. The weights of the governor E are seen to project through the arms of the wheel B and the movement of the governor is transmitted to an internal sliding spindle F. The carburetter is shown at G, while the exhaust and inlet manifolds are indicated by the letters I and H respectively. Compression release cocks are provided which are shown at J. A high-tension magneto is employed, which revolves at the same speed as the motor, and it is fitted with a special spark intensifier for starting.

The general arrangement of the motor and gearing in the wagon is seen in the accompanying illustration, Fig. 4. The wagon is of the standard gauge, and has a total distance between the axles of 12ft. 3in. The only constructional alteration made on the wagon was the replacing of the forward axle by a stronger axle on which the driving chain wheels are mounted, and a reinforcement of the axle springs. As will be seen from the plan view shown in Fig. 4, the engine and gear box are placed transversely in the front part of the frame, and the power is transmitted by two chains, which are so arranged that they do not interfere with the existing brake mechanism of the wagon. It will be noted that between the engine and the first passenger compartment a guard's van is provided, in which also the driving platform is accommodated. This disposition is convenient in that it enables the driver and conductor of the train to help one another in case of emergency. We have already described the motor, the fly-wheel of which embodies a special clutch K of the Baudoux type, which has been designed to deal with the heavy load when starting. Considerable improvements have been made in the clutch mechanism, and we understand that a new type of clutch has been evolved and will shortly be tested. The gear box shown at L provides four forward speeds and one reverse speed, the speed change being carried out by sliding gears which are operated by the one lever M on the driving platform. Alongside the

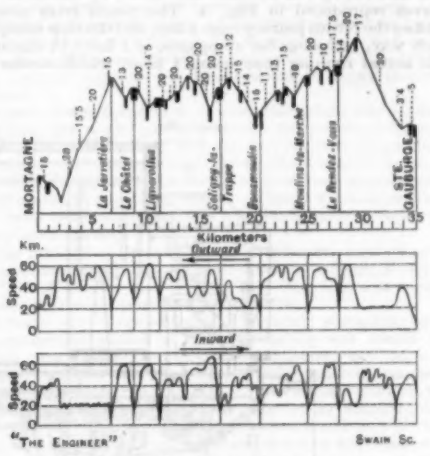


FIG. 3—GRADIENTS AND SPEEDS

speed control lever M is placed the air brake control lever N. Referring to the transmission, the first speed reduction is obtained by means of a chain R which drives from the secondary shaft on to the countershaft P, which is carried by a hanger connected with the fore part of the frame by a tension link Q, that imparts the necessary tension to the driving chains. There are two driving chains S S, which transmit the power to sprocket wheels fixed on to the front axle. All the shafts are provided with ball bearings. The motor is water cooled, and the cooling system includes a radiator T, the cooling water being circulated by a pump driven by the engine. The exhaust gases from the engine pass into the funnel X, which also serves as a ventilation duct. There is a compressed air self-starter, and compressed air is also used for the brakes and the whistle. The petrol tank is arranged underneath the van floor.

The engine develops 62 horse-power at 1000 revolutions per minute and 72 horse-power at 1200 revolutions per minute. The vehicle weighs 15 tons and, with load, 16.7 tons. The following table gives the speeds for the different gears as well as the torque on the wheels, these figures being based on the assumption that the mechanical efficiency is about 85 per cent :—

Gear.	Speeds. 1000 r.p.m. Kilom.	Speeds. 1200 r.p.m. Kilom.	Torque. Kilogram-metres.
First	12	14.4	1230
Second	20	24	720
Third	34	40	440
Fourth	50	60	280
Reverse ..	12	14.4	—

Having before him a speed indicator in conjunction

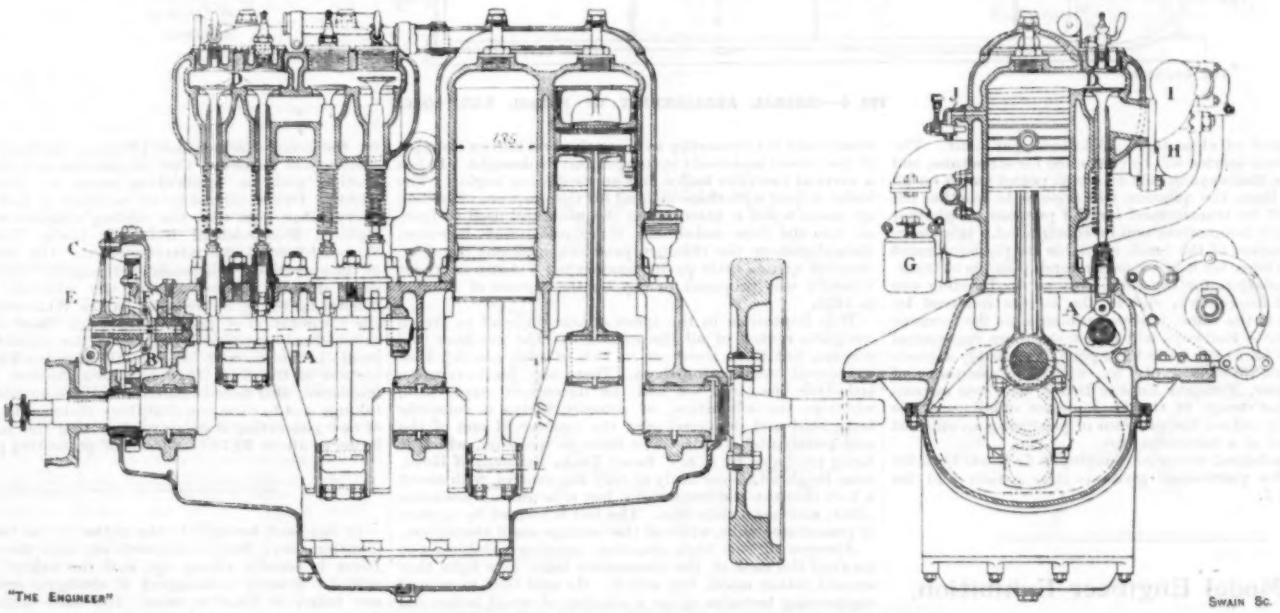


FIG. 2—SECTIONS THROUGH ENGINE FOR PETROL RAIL COACH

with the above table, as well as a table giving the speeds attainable on the different gradients, the driver knows exactly when he has to change gears. With the motor vehicle alone he only comes down on the second speed on a gradient of 25 mm. per metre when the speed is 24 kiloms., but when hauling a 10-ton coach he must come down on the first when the speed is 14 kiloms. On a gradient of 10 mm. per metre the top gear gives a speed of 45 kiloms., and with a trailing coach the speed with the third gear is 32 kiloms. On the level the speeds are respectively 60 kiloms and 58 kiloms. It is found that a man having no previous knowledge of driving readily gets into the way of handling this vehicle.

Trial and Working Results.

The rail motor with one trailing coach has been in service on the line between Mortaigne and Sainte-Gauburge since September 22nd. This line is a constant succession of gradients, many of them as much as 20 mm. per metre, and the length is a little more than 35 kiloms. The results of the trial run made on August 11th over this line and the speeds attained are shown by means of the curves reproduced in Fig. .3 The petrol train accomplishes the return journey once a day, and the time occupied each way, including ten stoppages, is 1 hour 10 minutes, the actual running time being 1 hour, which means an average speed of close upon 36 kiloms. per hour. The trials in actual service will be continued for some time, and if the State Railways decide to adopt petrol trains on all their local lines, the question will arise as to whether old coaches will be transformed for the purpose or whether special petrol locomotives will be constructed. It appears to be a question of the funds available for the equipment of the local lines, for it is, we understand, possible to transform two coaches for the same cost as for building one new petrol locomotive, and as the service rendered by both types is the same, it seems probable at the moment that the State Railways will adopt the more economical course. So far as the trials have gone, it certainly appears that Messrs. Schneider et Cie., with the assistance of their engineer, Monsieur Eugène Brillié, who was responsible for the design of the Paris motor omnibuses, has satisfactorily solved the problem of producing an efficient motor coach at a minimum cost.

We are indebted to our contemporary *Le Génie Civil* for some of the particulars given in this article and for Figs. 2 and 3.

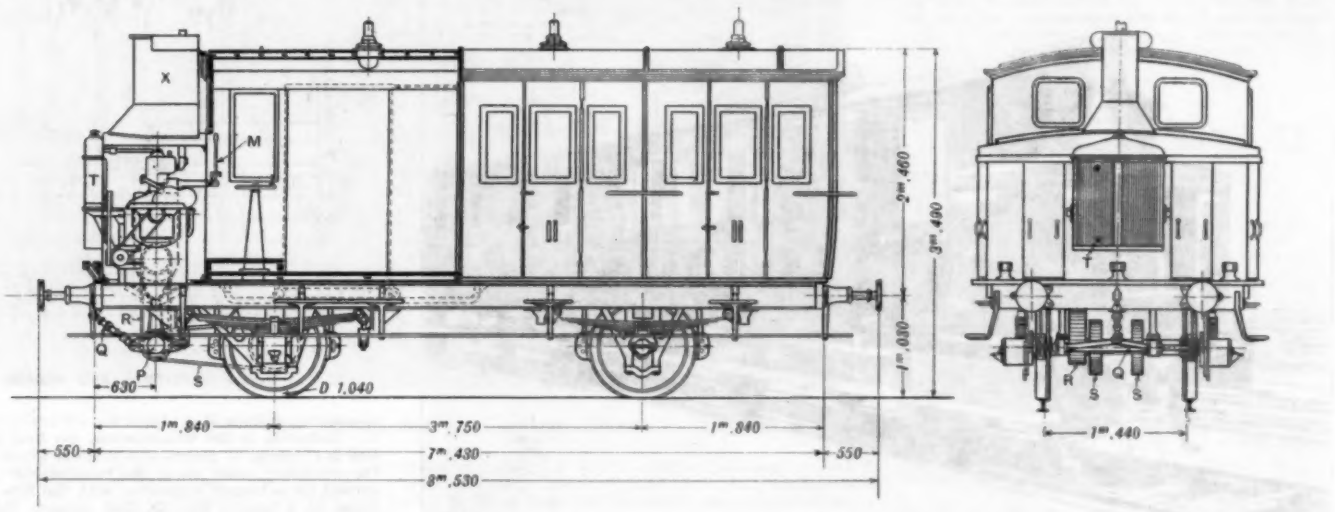


FIG. 4—GENERAL ARRANGEMENT OF PETROL RAIL COACH

The Model Engineer Exhibition.

One very satisfactory impression gained during a tour of the Model Engineer Exhibition, at the Royal Horticultural Hall, was that the prices of machine tools, or, at least, of the smaller classes of machines, are coming down decidedly. In some cases the reduction has reached as much as 20 per cent. during the past twelve months. Another fact which was amply demonstrated was the increasing interest of the public in general in what might be described as mechanical pastimes. The hall was crowded with visitors all day long; in fact, so crowded that it was not always an easy matter to get close enough to the stands to study the exhibits. However, the popularity of the show was a fine testimonial to the organisers, Messrs. Percival Marshall and Co., the proprietors of the *Model Engineer*.

Scanning the exhibits as a whole, they did not seem strikingly different from those at the previous exhibitions, although there were a few notable exceptions; but it was noteworthy that many more firms are now taking up the manufacture of small lathes and similar tools than was the case a year or so ago. It is possible that the resulting competition is responsible to a large extent for the reduction in prices just mentioned.

In that section of the exhibition devoted to "lent" models there were several of exceptional interest, and as an example of painstaking work that made by Mr. E. J. Windsor deserves the highest praise. It represents an engineering workshop on a scale of 1in. to 1ft., including fourteen machine tools complete to the most minute detail, and all workable. Two other interesting models were a locomotive and a steam boat lent by Sir John Thornycroft. Both were made by Thomas Thornycroft, father of Sir J. I. Thornycroft, and it seems to us that they support the suggestion put forward in these columns when we reviewed the Model Engineer Exhibition last year that acquaintance with mechanical devices in early life must help the young engineer to success in after life. The locomotive just mentioned was made for John I. Thornycroft when he was a boy, and is 3ft. 6in. long. It was overhauled in 1920, and driven by Sir John at the celebration of his golden wedding in that year. The model steam boat is noteworthy as being the first known example of the closed stokehold system of forced draught. It has a vertical fire-tube boiler and an oscillating engine. The boiler is fired with charcoal, and for the purposes of getting up steam a fan is fitted under the deck and used to force air into the close stokehold. When under way, however, the exhaust up the chimney produces sufficient draught. Another quaint little model represented a steam cabriolet which it was proposed to put on the streets of London in 1833.

It is impossible in the space at our disposal to give a complete review of all the exhibits of the machine tool makers, but there were one or two of such novelty that we cannot but mention them. There was, for instance, a lathe for 50s., and we had the uncommon experience, while at the exhibition, of actually seeing a complete lathe sold and delivered over the counter of one of the tool merchants' stands. The lathe in question, which is being produced by C.A.V. Small Tools, Limited, of Hove, near Brighton, is certainly of only 2in. centres, with about a foot between the headstocks, but it is quite a workable affair, and has a slide rest. The bed is formed by a piece of ground steel tube, while all the castings are of aluminium.

Apropos of this little machine, another exhibitor put forward the case of the diminutive lathe in a light that seemed rather novel, but sound. He said that in several engineering factories quite a number of small lathes are employed in much the same manner as jigs. They are set up to do a definite job and kept in the store. It is only necessary to tighten a couple of bolts to fix them down and connect them with a countershaft by means of a gut band. The low price of these small lathes justifies, he said, setting them aside for individual operations rather than spend time and labour in changing the setting of a machine.

Another lathe, which was on the stand of Hobbies, Limited, of Dereham, Norfolk, embodies the novel driving gear mentioned a few weeks ago in our patent specification extracts. A chain is used to connect a sprocket on the fly-wheel shaft—it is a foot-driven lathe—with another on the headstock. The two sprockets can be interchanged and two driving speeds thus obtained. The sprocket on the headstock is connected with the mandrel by a train of three gear wheels, which also can be interchanged, several alternative holes being provided for the stud carrying the idle wheel. The arrangement provides fourteen different speeds, advancing in geometrical ratio, for the mandrel, while the fly-wheel is treadled at the normal speed. The range of speed is from about 70 up to 2500 revolutions per minute. This lathe possesses several other novel features, but we will not enlarge upon them here.

The exhibition, which, it is needless to state, included all kinds of models by the well-known makers, and also a quantity of wireless apparatus, closes this evening.

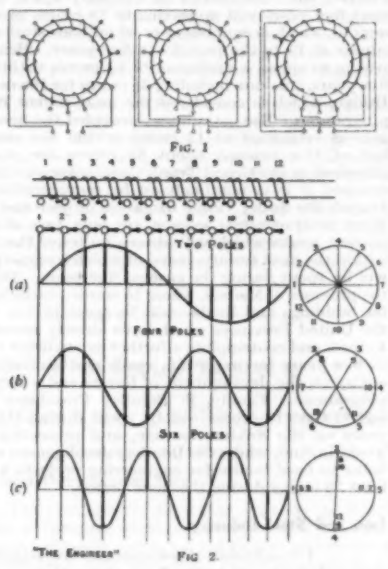
THE ELECTRICITY COMMISSIONERS.

The applications relating to the establishment of new generating stations which were under consideration by the Electricity Commissioners during the year ending March, 1922, are dealt with in the second annual report of the Electricity Commissioners, which has just been issued. The application of the County of London Electric Supply Company to establish a generating station at Barking was agreed to. Consent was given to the Preston and Salford Corporations to establish new stations, but permission for the South-Eastern and Chatham Railway to build a station was refused. The conclusions arrived at in connection with an application made by the Yorkshire Electric Power Company to establish a new station at Ferrybridge were that the existing stations at Bradford, Halifax, Huddersfield, Keighley, Leeds, Thornhill and Wakefield should be interconnected. The existing plant at those stations, it is considered, together with the extensions already authorised and the addition of another generating set to be installed in the Whitehall station of the Corporation of Leeds, will, when those stations are satisfactorily interconnected, meet the estimated requirements of the district for several years pending the completion of the first stage of a new station. The Commissioners also issued consents to three authorised undertakings and to nine non-statutory undertakings in respect of new generating stations representing the initial installation of about 30,780 kilowatts of generating plant.

It has been brought to the notice of the Calcutta Corporation, says *Indian Engineering*, that the Bidyadhari River is rapidly silting up, and the safety of the city will be gravely endangered if dredging operations are not taken in hand at once. The chief engineer to the Corporation reported that the final stages in the decay of the river had commenced, and if they were not immediately arrested, Calcutta would become landlocked in about a year's time—two years at the very outside; and if this were allowed to happen, there would be no outlet for either the sewage or the storm water of the city, a state of affairs too terrible to imagine. "The time for deliberation," he added, "has passed; something must be done immediately. There is no time to put in a complete final scheme, which would take four or five years to construct, even if sanctioned now. The only thing to do is to commence dredging operations at once." In a letter to the chairman of the Corporation, the Chief Engineer to the Government of Bengal states that if nothing is done immediately drainage will be practically impossible the following year.

Variable-Speed Alternating-Current Motors Without Commutators.*

WITHOUT ignoring the work of early inventors, such as Dahlander and Lindström and Alexanderson, who have provided means of adapting a single winding to give, for instance, two numbers of poles having a fixed ratio, it is not unfair to say that the idea of using the method of pole changing to produce a machine having anything resembling a gradual variation of speed by small steps between wide limits, would have been regarded a few years ago as chimerical. Yet it is also obvious that if by any means we could render practically available all the numbers of poles which exist within a given range, we would have a machine with a very high degree of practical usefulness. For instance, on fifty periods between the speeds of 375 revolutions per minute and 1000 revolutions per minute there are six numbers of poles available.



One method by which all these numbers of poles might theoretically be rendered available with a single winding has long been known, *i.e.*, the use of a ring winding tapped at the various points necessary to give different numbers of poles—as shown in Fig. 1. It is well known that a ring winding can be used on any number of poles, if a number of equidistant tappings equal to three times the number of pairs of poles are brought out on each speed, equaliser connections being made between tappings 1 to 4 throughout the circumference. To obtain six numbers of poles from the same winding in this way, however, would require a formidable number of tappings, and to connect them together in the various manners required would involve an equally formidable type of switchgear. Various other difficulties are also met with.

The solution to all these difficulties was only found gradually. In order to overcome the necessity for a very large number of terminals, a method of pole changing entirely different from that described above was adopted. This method is shown in Figs. 2 and 3. Still considering a ring-wound machine, assume it to be divided into twelve sections, shown developed in Fig. 2.

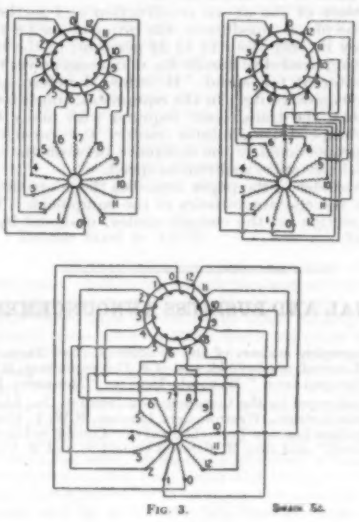
At this point it may be convenient to describe a diagrammatic method of denoting the windings of alternating-current machines which I have developed in order to simplify winding diagrams. It will be seen that the ring winding shown at the top of Fig. 2 is divided into twelve sections, each section being shown as consisting of two turns. The beginning of each section is denoted by a white circle and the end by a smaller blackened circle, the extremities of the various sections being connected in series in the usual manner. An obvious simplification for diagrammatic purposes is to omit the drawing of the winding and merely retain the two terminals of each section, joining them by a straight line in order to show that they belong to the same section. This diagrammatic method of denoting the winding is shown immediately below the drawing of the ring in Fig. 2, the sections being numbered in order round the circumference, and the method is made considerable use of in these notes.

Imagine the twelve sections of the ring winding shown in Fig. 2 to be carrying currents differing in phase from one another by 60 deg., the current vectors being shown on the right of Fig. 2 (*b*), the current in section 1 having a phase 0 deg., that in section 2 having a phase of 60 deg., that in section 3, 120 deg., and so on. These vectors when projected on a vertical axis in the usual way give, of course, the instantaneous currents in the different sections, which may be plotted as shown on the left of Fig. 2 (*b*). We thus obtain a series of ordinates, the extremities of which lie on a sine curve, having two positive and two negative maxima, *i.e.*, four poles on the circumference. If, however, we so reconnect these sections that the phase difference between adjacent sections is 30 deg., and plot out the ordinates as in Fig. 2 (*a*), we obtain another sine curve having one positive and one negative maxima, *i.e.*, two poles, while if we make the phase difference between the sections 90 deg., as in Fig. 2 (*c*), we obtain a curve having three positive and three negative maxima, *i.e.*, six poles.

In Fig. 3 are shown the connections whereby this change of phases may be accomplished for the case of thirteen phases, which is practically more convenient in some respects. As will be seen, it involves the use of thirteen terminals on the motor—still shown as a ring winding—and some means of producing a number of phases—viz., thirteen—equal to the number of sections in the motor winding. Since thirteen-phase distribution is never used, this involves some means of converting from the usual three-phase supply to the number of phases required by the motor and a new piece of apparatus, the phase transformer or converter, is required with this method of control.

When we realise that this method of control involves a phase converter, it may appear as if we had merely simplified the switching by introducing another piece of apparatus which will cost as much as the switchgear with which we have dispensed.

It will be shown later, however, that this is far from being the case. The construction of this phase transformer with a suitable degree of simplicity involves problems of its own, particularly where a large number of phases are required. The method of solving these problems will be described at a later stage.



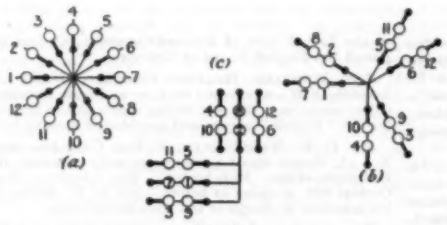
Although the simple method of pole changing just described was sufficiently encouraging to justify the construction of one or two machines for special purposes, it was not found sufficiently simple to be the final solution of the problem. Experience showed that even the number of terminals possessed by such a motor was too great in practice if a large number of speeds, *e.g.*, five or six, was aimed at. In this case the number of terminals is not less than thirty, which was found to be not a practical number, and still further means of simplification were therefore sought.

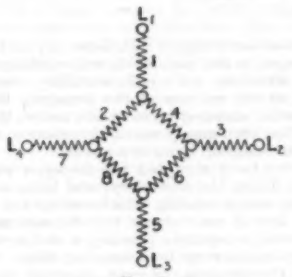
It was found possible to reduce the required number of terminals in several ways. It is clear, first, that wherever we have currents differing 180 deg. in phase, that is to say, mutually reversed, it is not necessary to supply two distinct phase-transformer terminals to obtain these two phases. If the two sections are connected in series or parallel, mutually reversed, they can be supplied from a single terminal.

For instance, returning to Fig. 2, if we wish to connect the motor only for two poles and six poles we find that in both these cases sections 1 and 7, 2 and 8, &c., are diametrically opposite in phase. We may, therefore, connect them in series reversed, as shown in Fig. 4 (*b*), in which the sections are denoted by the diagrammatic method already described, and the direction of the straight line joining the two extremities is made to represent the phase of the current in the section.

Connecting all the sections in star, we require twelve terminals to give two poles. Connecting opposite sections in series reversed we require only six, although if we compare Figs. 4 (*a*) and 4 (*b*), we see that each section in the latter is parallel to the same section in the former, *i.e.*, it carries current of the same phase.

The same connection—viz., diametrically opposite sections connected in series reversed—is also available on six poles, and the diagram for this is shown in Fig. 4 (*c*). Hence, we see how by making use of this simple device we may materially reduce both the amount of switching and the number of terminals required on the phase transformer.





A second method of reducing the number of terminals consists in putting alternate sections of the winding in mesh and the remainder in star, the mesh being connected in the centre of the star, as shown in Fig. 5, for the case of eight sections and four phases.

It will be seen from this figure that the mesh sections are intermediate in phase between the star sections, *e.g.*, section 2 is intermediate in phase between sections 1 and 3, and so on; thus, although the winding connected, as in Fig. 5, requires only four terminals, the E.M.F.'s across the various sections are nevertheless in eight distinct phases.

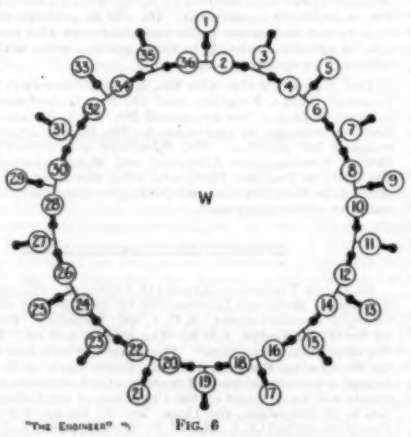
Again, it was found in most cases that while this method of connection might suffice to double the number of phases on a particular number of poles, yet in order to produce the same result on another number, the whole or many of the sections must be disconnected from one another and reconnected in a different order. Thus it would seem that we have only simplified the transformation in order to complicate the switching.

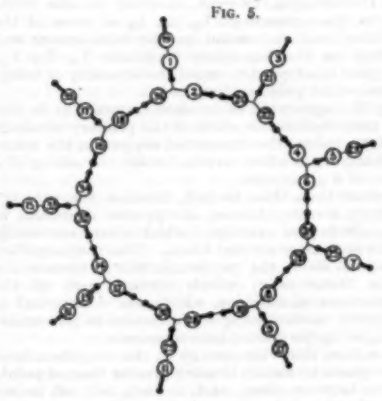
The method of reversal and the star-mesh method may be combined, and thus we may obtain windings in which the E.M.F. across the sections has four times as many phases as that supplied to the terminals.

After a very large amount of research, extending over a considerable period of time, a winding was found in which this result could be accomplished, not on one number of poles only, but over a large series of numbers covering a speed range of 3—1 or more, without reconnecting the winding in any way when changing the numbers of poles. This winding is shown in Fig. 6 for the case of thirty-six sections, eighteen of which are connected in mesh and an equal number connected in star to the angles of the mesh, alternate sections in the mesh being mutually reversed and alternate sections in the star being also mutually reversed, the mesh sections alternating with the star sections around the circumference of the machine.

The winding shown in Fig. 6—containing only eighteen terminals—can be, and is being, frequently used on all numbers of poles from six to sixteen and is, with a slight further modification, also capable of being used on further numbers of poles from twenty to twenty-six.

This connection, therefore, gives us not only a winding of a very simple character with a moderate number of terminals—eighteen—capable of reconnection in a simple manner for a large number of different numbers of poles, but it also gives us the characteristic which was shown above to be desirable, viz., that of having an approximately constant flux in all numbers of poles. It is difficult to explain the cause of this in a simple manner, but one may say briefly that it is due to the fact that the number of sections in series between terminals having a given phase difference of, say, 120 deg., becomes gradually greater and greater as we increase the number of poles, or decrease the speed, so that as the rate of rotation of the flux wave gets less and less, due to the decreasing speed of the motor, the voltage across any section having a given number of turns also becomes less and less approximately in the same proportion, and thus about the same flux is needed to balance this voltage at all speeds.





A further simplification is possible where, for instance, only odd numbers of pairs of poles are required and, consequently, diametrically opposite sections are always opposite in phase on every number of poles which a

* Abstract of paper read before the Institution of Electrical Engineers by Mr. F. Creedy.

machine is required to give, and, therefore, may be permanently connected in series, mutually reversed.

The winding of such a machine as shown in Fig. 7 and, as will be seen, has only nine terminals, capable of operating on two, six, ten and fourteen poles, and, with a slight further modification, on twenty-two and twenty-six poles. This winding is, I believe, the simplest known multi-speed winding. It requires no more than nine phases, while the original winding may require eighteen phases.

THE PHASE CONVERTER.

Having described how the difficulties connected with designing a multi-speed winding have been overcome by means involving the use of a phase transformer or converter, it will next be desirable to describe how this apparatus is constructed in practice. In certain cases, *e.g.*, where a single motor is operated from a generator which serves no other purpose, as in ship propulsion, no such transformer is needed, as there is no difficulty in winding the generator for the number of phases required; but in the majority of cases the machine, if it is to be of any practical use whatever, must operate from a power supply having, say, not more than three phases, and hence it is of vital importance to the practical success of the apparatus that this phase transformer should be not merely technically satisfactory, but should also be capable of being built at a very moderate price.

By restricting the number of phases to multiples of three, the transformers to be excited from a three-phase circuit may be simplified very materially, and it will be convenient to describe the transformer as used in connection with the winding previously referred to. This transformer does not differ externally in any way from the standard three-phase core-type transformer, built in the usual way with three exactly similar limbs. The connections, however, are as shown in Fig. 8, in which all the windings shown by lines parallel to one another are considered to be wound on the same limb of the transformer. Since the windings shown in this figure are drawn parallel to three straight lines at 120 deg., it follows that only three such limbs are needed.

If we take a three-phase transformer having two secondary sections on each limb, and connect these sections in the manner shown, which may be called a hexagon connection, we obtain an apparatus from which six-phase currents may be derived by bringing out terminals from

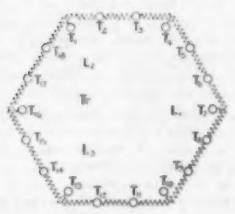


FIG. 8.

"THE ENGINEER"

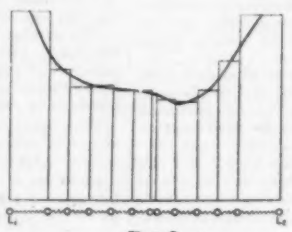


FIG. 9.

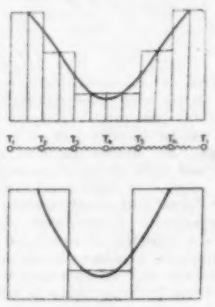


FIG. 10.

DRAWN BY

the corners of the hexagon. If, however, we tap the sides of the hexagon in the manner shown, winding on the three limbs, in addition, six small, auxiliary sections to be connected to the corners of the hexagon, it is possible without further elaboration to obtain no less than eighteen phases, as has been amply proved in practice, the tappings shown in the diagram lying in a circle.

So far, we have regarded the hexagon winding with tappings as being the secondary, and have assumed that there is a primary winding which carries the three-phase currents. But if no voltage transformation is needed, as in this case, a separate primary is not needed, for the primary terminals may be connected direct to alternate corners of the hexagon, or even, in order to save extra terminals, to the extremities L_1, L_2, L_3 of three of the small auxiliary sections wound on the transformer and corresponding to the secondary terminals T_1, T_7, T_{13}. This latter plan is adopted to avoid the necessity of bringing out three extra primary terminals.

By using the apparatus as an auto-transformer in this way we at once abolish the whole of the primary windings and, therefore, reduce the amount of copper on the transformer to half, or, in other words, double the rating of a transformer of a given size.

We do more than this, in fact, because the primary and secondary currents flowing in opposite directions in the same windings give a resultant which is very materially less than the secondary current alone. This is exemplified in Fig. 9, which shows the currents in the sections of the thirty-phase transformer, which formed part of the original experimental machine, which was constructed to test the present method of speed variation in its earliest form, L_1, L_2 being the three-phase terminals.

It will be seen that the current in the neighbourhood of the three-phase terminals is much greater than at points intermediate between them, and, in fact, falls off to less than one-half at a point midway between the terminals.

Fig. 10 shows a similar curve for up-to-date nine-phase and eighteen-phase transformers as now being constructed commercially by the Metropolitan-Vickers Electrical Company for use with these machines. The same reduction in current per section at a point intermediate between the three-phase terminals T_1, T_7 is noticed here, and the analogy between the reduction of current in these transformers and the similar reduction which takes place in the armature of a rotary converter in sections intermediate between the tapping points may be referred to.†

As a result of this further reduction a phase transformer to transform a given amount of power, say, from three to nine or eighteen phases, will require a size of transformer of only between 30 to 40 per cent. of the rating of the transformer which will be required to convert the same amount of power, say, from one voltage to another.

† I hope to publish the full theory of these phase converters on another occasion.

Still another economy which has the effect of still further reducing their capacity can be effected in the use of these phase converters. In a constant-torque motor giving a horse-power proportional to the speed, the amount of power taken will also be approximately proportional to the speed. For instance, the power taken at 750 revolutions per minute will be only 0.75 times the power taken at 1000 revolutions per minute, and if we can arrange the winding of our motor so that it is directly connected to the line when operating at 1000 revolutions per minute, the phase converter not being used on that speed but coming into operation for the first time only at 750 revolutions per minute, we shall be able to reduce its capacity to 0.75 times the value which would be needed to supply the power required at 1000 revolutions per minute. By way of analogy to this plan, we may refer to an automobile gear box in which it is usual to give direct drive on the top speed, thereby reducing the amount of power to be transmitted by the gears. The above is the electrical form of the direct drive.

As a result of the above construction and method of utilising the phase transformer, the rating of such a transformer may be only from 18 to 22 per cent. of the transformer rating needed to handle the maximum power taken by the motor at top speed. It forms, therefore, by no means an expensive item in the equipment, much less so, in fact, than the transformer required with many types of variable-speed commutator motor, the capacity of which is proportional to the difference between the speed of the machines and synchronous speed.

The remainder of the paper describes the controller and deals with the chararacteristics of the equipment. There is also a section on the cascade motor, designed by Mr. L. J. Hunt.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

THE telegraphic address of the London office of Thos. Firth and Sons, Limited, of Sheffield, and of 8, The Sanctuary, S.W. 1, has been changed from "Mesmeric Vic." to "Mesmeric Parl."

WE are informed by the Considère Construction Co., Limited, of 72, Victoria-street, Westminster, London, S.W. 1, that the name of the firm has now been changed to "Considère Constructions, Limited," and that M. Pelnard-Considère and M. Caquot, of the French firm of Pelnard-Considère, Caquot et Cie, have joined the English board of directors.

THE WEMBLEY HEATING COMPANY, Limited, Wembley, London, N.W., advises us that, as and from January 1st, 1923, it has taken over the sole selling rights in the United Kingdom for the "Elphia" garage and greenhouse heating boiler.

MR. C. H. WORDINGHAM, M. Inst. C.E., has removed from No. 11, Mosley-street to more centrally situated offices at 33, Brazenose-street, Manchester. His telephone number, viz., Central 828, remains as before. Mr. R. W. Willis, M.I.E.E., is his assistant in charge of the Manchester office.

WE are informed that the services of Captain A. C. Burgoine, M.I.A.E., lately of the Directorate of Research at the Air Ministry, have been secured by Lodge Plugs, Limited, of Rugby, for its technical department. He will be available for consultation by car and motor cycle manufacturers who may have any special problems relating to their ignition gear, with particular reference to sparking plugs.

THE KEIGHLEY GAS AND OIL ENGINE COMPANY, Limited, of Imperial Works, Keighley, and 59, New Oxford-street, W.C. 1, informs us that it has appointed Mr. W. A. Sycamore to be its London manager in succession to Mr. H. S. Aspinall, who has resigned his position. Mr. Sycamore was formerly with the British Westinghouse Electrical and Manufacturing Company, Limited, at Trafford Park, and after the Armistice joined the staff of the Keighley Gas and Oil Engine Company, Limited, as a member of its selling staff.

SILVANUS THOMPSON MEMORIAL LECTURE.—The first Silvanus Thompson Memorial Lecture will be delivered at the Technical College, Leonard-street, E.C. 2, on Thursday, February 1st, by Sir Oliver Lodge, F.R.S. The subject will be "The Basis of Wireless Communication." The chair will be taken at 7.30 p.m. by Sir Charles Parsons, K.C.B. Doors open at 7. After the lecture a conversazione and reunion of old students will be held; guests will be received by the Chairman of the College Delegacy, Mr. L. B. Sebastian, the Dean, Dr. W. Eccles, F.R.S., and the President of the O.S.A., Mr. W. M. Mordey, past-President, I.E.E. A collection of Dr. Thompson's paintings and apparatus will be shown and a number of scientific demonstrations will be given in the laboratories by eminent past students and associates of the College.

CONTRACTS.—The Borough of Hammersmith has placed an order with William Shepherd and Sons, Limited, of Milkstone, Rochdale, for the re-surfacing of about twenty roadways in its district.—The contract for a bridge comprising three 50 m. spans, each weighing just over 300 tons, has been awarded by the Buenos Ayres Great Southern Railway to the Horseley Bridge and Engineering Company, Limited, of Tipton, Staffordshire.—The Becco Engineering and Chemical Company, Limited, 158–160, City-road, E.C. 1, has received a contract for one of its "Becco-Legg" water softeners, for softening the water for a range of Babcock and Wilcox boilers at J. S. Fry and Son's new works at Keynsham, Somerset.—George Kent, Limited, have recently received an order for additional Venturi meters for the Bombay Municipality, one 48in. for Vehar main and one 60in. for Tansa main pumping plant. Two 57in. Kent Venturi meters have recently been dispatched for the latter project.

Indian Engineering Notes.

(From our own Correspondent.)

BOMBAY, December 16th.

A Five Years' Programme.

A RECENTLY published despatch from the Viceroy to the Secretary of State for India discloses for the first time the huge engineering projects which are pending in this country. Some of the provinces have provisionally budgetted twenty years ahead for major projects in connection with irrigation and hydro-electricity supply, and the total figures are stupendous. In the provinces of Bengal, Bombay, Madras, the United Provinces and the Punjab, the expenditure on capital projects during the next five years will approximate 18 crores of rupees per annum, which is equivalent to 60 millions sterling—taking rupees at 15 to the pound—in five years. Bengal is preparing to spend a minimum of 7½ crores within the next five years, this sum including 3½ crores for the new Howrah Bridge, which is considered the most urgent item in the programme. The maximum—provided the money can be got—is estimated at 13 crores within the same period, but of this amount about 3½ crores are provisionally allocated to the Grand Trunk Canal scheme, which will be dropped if it is not likely to be remunerative. In the Punjab the Sutlej Valley irrigation project and the Sutlej River hydro-electric scheme are only two of many important works which will absorb no fewer than 47 crores within the next twenty years, of which 3 crores per annum will be spent during the ensuing five years. Then there is the province of Madras, where 15 crores—including 4 crores for buildings and roads—will be spent in five years, and the United Provinces which have already raised a loan of 4 crores and contemplate a further expenditure of 10 crores in five years for irrigation, roads and sanitation, capital outlay on the development of forests and a large building programme. Finally, in Bombay Presidency it is estimated that 14 crores will be spent during the next five years on the Sukkur barrage, and protective irrigation works in Sind, whilst the Bombay development scheme and loans to local bodies for engineering projects will need at least 25 crores during the same period.

Iron and Steel Industry.

Considerable developments are reported in the iron and steel industry in India, for within the space of a couple of weeks two large blast-furnaces have been put into commission. The first of them, which has an output of 400 tons of pig iron per day, has been installed at the Hirapur (Asansol) works of the Indian Iron and Steel Company. For a few days this plant possessed the distinction of being the largest in India, but then it was eclipsed by a new furnace, having a capacity of from 500 to 600 tons per day, which was tapped for the first time on December 6th at the Jamshedpur works of the Tata Iron and Steel Company. The plant at Asansol also includes a by-product coking plant, which handles 1800 tons of materials per day, and it is understood that this plant, and also the 400-ton blast-furnace will be duplicated early in the New Year.

Industrial Housing.

A few days ago his Excellency Sir George Lloyd, Governor of Bombay Presidency, inaugurated an industrial housing scheme, which will provide accommodation for a quarter of a million people within the next six years. This is an essential part of the Bombay development scheme, which has for its object the provision of badly needed housing accommodation for all classes of the community. More particularly, however, the industrial housing scheme will cater for the needs of the ever-increasing number of employees in mills and factories, many of whom are living under sanitary conditions which are positively revolting. There are, indeed, slums in Bombay—not isolated districts, but whole "bazaars"—which are 100 per cent. worse than anything that has ever been seen in London, New York or San Francisco; but the authorities are unable to deal with them until alternative accommodation is provided for the inhabitants. The scheme inaugurated by the Governor will ultimately comprise 625 reinforced concrete tenement buildings, locally known as "chawls," each of which will contain accommodation for eighty families. About twenty of these buildings are already completed, and the remainder will be erected at the rate of about 100 per year.

A Bolt from the Blue.

The city of Calcutta is in serious trouble with its drainage system. As is well known, the sewage and storm water of Calcutta outfalls into the Bidhyadhari River, which for some years past has been silting badly. Now the Chief Engineer to the Irrigation Department of the Government of Bengal reports that the silting has increased to such an extent that unless something is done immediately the drainage of the city into the Bidhyadhari will be impossible within a year. Thus, without a word of exaggeration, a city of a million people is likely to become uninhabitable. Dredging is advocated, and a dredger is available, but there are no funds available for carrying on the work. This, of course, is an *impasse* which cannot continue, but the serious part of the whole matter is the statement, on the authority of the Chief Municipal Engineer, that dredging is at the best a makeshift, and that a complete new scheme will have to be evolved for the disposal of the sewage of the city. The problem has been delegated to a special committee, with instructions to report within a week. To those who know India and its dilatory ways, the urgency of the matter is exemplified by the previous paragraph.

News in Brief.

New plant on site and on order will increase the capacity of the Cossipore (Calcutta) electric power-house from 21,000 to 57,000 kilowatts.

The capital of the Karachi Electric Supply Corporation is being increased, and the plant doubled, for the third time since its inception in 1914.

A municipal cold store has been erected by Bombay municipality.

A number of wireless telephone sets have been installed in the Moplah tracts of Malabar, South India. It will be recalled that during the Moplah disturbances last year the rebels systematically cut the telephone and telegraph wires, and thus rendered communication practically impossible.

The opening of an electric power station in Rutlam, a tiny yet progressive Native State, having an area of no more than 871 square miles, is typical of the modern spirit which is enveloping India. The new plant is small, consisting only of three 55-kilowatt sets, coupled to crude oil engines, but in India it is modest beginnings such as these that stand the best chance of success.

The latest addition to the rapidly increasing number of cement factories in India is the one in Gwalior State, which is expected to begin operations early in the New Year. Progress is also being made with a new cement works at Shahabad, in the Nizam of Hyderabad's dominions. Both these concerns are under the management of Tata Sons, Limited, the latter being a link in the chain of "Tata" companies which manufacture most things from steel to cocoanut oil.

Mr. W. H. Neilson, O.B.E., Chief Engineer, Bombay Port Trust, has been elected chairman of the Bombay Association of the Institution of Engineers (India) for the ensuing year. The new chairman of the Bengal Association of the Institution is Mr. G. B. Williams, chief engineer, Public Health Department, Bengal.

The post of Chairman of the Calcutta Port Trust is made vacant by the appointment of Mr. C. D. M. Hindley to be Chief Commissioner of Railways in India.

Owing to trouble with its coal supplies, Calcutta proposes to acquire a municipal colliery.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Midland Iron Quarter Day.

THE first quarter day of the year for the Midland iron trade in Birmingham this week proved, if not a direct inspiration, certainly quite an optimistic gathering, and ironmasters have gone from it all over the kingdom with a more confident belief in the trade revival foretold for 1923 than was in some quarters anticipated. Not only so, but, better still, prices in all branches show improvement, and in various directions definite advances in iron and steel are this week announced. Declarations of advances are eminently satisfactory and do more to encourage ironmasters than anything else. With a revival of shipbuilding and both home and foreign railways manifesting a tendency to replenish stocks, the Midland iron and steel trades can, it is this week very happily concluded, see indications of a heavier demand in the near future. It is usual for buyers to wait until after the January quarterly meeting of the Midland trade before placing New Year orders, and this week has been marked by increased orders of an unmistakable character. There are better prospects before the ironworks and forges. At a few of the rolling mills orders have been taken which will insure occupation for the next two months. If these cases are exceptional, order books generally have a more encouraging appearance. Many ironmasters still find it very difficult to obtain regular occupation, but the quarterly meeting has shown that conditions are less precarious than they were. The main body of feeling on the Iron Exchange in Birmingham to-day—Thursday—unquestionably implies that there is more confidence on all sides, and that the signs of the times—the nature of inquiries, the lengthening character of orders and a disposition, if only in isolated cases, to make forward contracts—all point to a definite revival. Politics apart, many business men attending to-day's market from other iron-making districts of the kingdom, expressed their conviction that the advent of the new Government has made for security of trade and prospective redevelopment of industry. On the other hand, it is pointed out more strongly than ever that a reduction of national expenditure and a consequent relief from the burden of heavy taxation is of first importance if the iron trade is to improve permanently. It is necessary to keep well in mind that the iron trade has been saddled by the war with burdens which will, no matter how favourable the circumstances, prevent a reversion to pre-war prices for a long time yet.

Advance in Pig Iron Prices.

An improved demand for pig iron, which has been one of the outstanding features of this quarter day, is regarded with special satisfaction, the poor output of Midland raw material having been a disquieting feature for the last two years. Consumers now show more anxiety to make contracts, some transactions having taken place covering requirements until the end of the first quarter. Prices so far are not much advanced, the rise in value of Midland irons ranging up to 3s. per ton. A further advance is, however, certain very shortly in concert with the higher prices current in Cleveland. But there is a scarcity of basic pig iron enabling makers to raise their prices by 5s. and upwards. In Staffordshire, Warwickshire, and Worcestershire only seventeen furnaces are in blast. This, however, is practically double the number of a year back, and it is stated that some furnaces which were blown out nearly two years ago will be rekindled early next month. That there is some ground for the prophecy that a revival will take place in trade almost immediately appears from the circumstance that a couple of weeks or so ago one Staffordshire firm secured sufficient orders to occupy its furnaces during January and February. The high price of coke and the limited supply was strongly commented upon by furnace owners in Birmingham to-day—Thursday. It is apparent that existing resources are not compatible with a general revival in pig iron production if coke is to be sent abroad at the rate we have seen during recent months. The difficulty of making sure of regular fuel supplies on any practicable terms has retarded the restarting of more than one blast-furnace in the Midlands. However, the position is now a little easier, and smelters in Derbyshire, Northamptonshire, and Nottinghamshire are showing their faith in a righting of the position by blowing in additional furnaces.

Manufactured Iron Conditions.

The outlook for manufactured iron is brighter. The disorganisation of trade by the underselling of Belgium and Germany has sensibly abated with the rapid advance in their production costs, and the makers of Staffordshire common iron bars in particular are proportionately heartened. There have lately been far fewer incursions into the local market by the "cutters," though underselling is still spoken of. Belgian supplies are not being offered with as much importunity as was the case down to last autumn. In any case, consumers are dubious as to how far it is safe to rely upon continental deliveries. The fact is, everybody is, now that 1923 is with us, on the *qui vive* for a considerable trade development. Hence there is more anxiety to cover commitments and to buy ahead a little. Belgian iron forges are not able to undertake further deliveries of common bars in much less than six or eight weeks. Staffordshire mills which specialise in nut and bolt qualities, generally quote £9 15s. Some houses think the time is ripe for putting up the price to £10, but the market shows no readiness to go at such a pace. Iron strip has, however, appreciated to £10 15s. and upwards. Crown bars are £10 10s. upwards. The relapse in galvanised sheets has proved to be only temporary. They are now back to £17 10s. for 24-gauge corrugateds.

Dearer Steel in 1923.

All the indications point to a time of dearer steel this year. And, truth to tell, the increased stringency has not come before it was abundantly wanted. It has been some time since steelmasters were making any profits. Even if there were no other operating cause than internal competition, British prices of rolled material have been forced down to an unremunerative level for some months past. Now, however, something like a concerted action seems once more in operation amongst finished producers to stand up for their own. The fresh front was happily very prominent on quarter day at the Midland meeting. In sectional steel circles the impression is that the railway companies cannot long delay the buying of rolling stock and stores generally in view of the upward tendency of prices, and the new battleship contracts have also inspired fresh courage amongst heavy steel rollers. India is a very good buyer of steel, though most of this material goes from the North of England. Locally the demand from the railway wagon builders, the bridge builders and constructional engineers, and from the makers of tanks, safes, and the like furnishes the principal source of orders. At to-day's quarterly gathering there was quite a strong movement by the Staffordshire mills to raise prices. Quotations for bridge and tank plates were 10s., and in some cases 12s. 6d. to even 15s. per ton above the late minimum, while angles and joists were advanced 5s. Plates were quoted £9 10s. to £9 15s.; sections, £9; tees, £10; and boiler plates, £12 10s., delivered in the district. Small rolled steel bars were raised to £9 15s., and makers reported that they had recently received better orders from the district engineering branches, and that they believe that the strength of demand now makes it possible to put selling prices on an economic footing once again. Steel hoops were quoted £11 at works. Semi-finished material was firm at a further advance of 2s. 6d. per ton. Sheet bars were dearer at £7 7s. 6d. to £7 10s. For billets £7 10s. was the minimum, £7 12s. 6d. and £7 15s. being asked for special makes. Very few parcels of continental billets were on offer in Birmingham this week. Certain small lots are quoted £7 per ton, but in view of the small reliance placed upon deliveries, they are not proving attractive to British consumers. It is announced that improvements are in progress at the Spring Vale Steelworks, Wolverhampton, of Alfred Hickman, Limited, in the hope of developing this big undertaking to its fullest extent. A new mill is in course of construction which, if the promised boom materialises, should have the effect of absorbing much more labour than formerly. Messrs. Hickman, I may here remark, incidentally regard the reduced rail rates with a great deal of satisfaction. Being so far inland, the question of rates of transport has always been a serious matter for consideration to Staffordshire steel masters.

Birmingham Engineering Trades Outlook.

It is fitting that I should add here to what I had to say in my last week's letter about engineering prospects for 1923, that some encouraging new currents of business are becoming perceptible in the Birmingham engineering branches. The rehabilitation of credit, incomplete though it is, begins to make itself more definitely felt, and the Government has shown itself alive to the importance of affording what stimulus it can to the movement. A pleasing portent is the continued appreciation in the value of sterling. Industry has been drained of vast sums of ready money, but the drastic measures taken to keep our future liabilities for borrowings within strict limits, enable us to look forward more sanguinely than can most competing countries. With more regular market conditions also, enterprise is taking fresh heart, and I hear of long postponed projects at home and abroad coming to the front again. High hopes are entertained that the re-grouping of the railways will result in substantial contracts. There is a great deal of development work that is long overdue. The dovetailing of the different systems which have been grouped will involve many adaptations if the economy and efficiency promised by the reorganisation are to be realised. It is already evident, moreover, that there will be keen competition for traffic between the various groups. Far-reaching policies are being launched, as can be seen in the Birmingham area, for placing alternative routes at the disposal of trade, and for developing main streams of traffic between the industrial districts and the ports by means of key positions which the different interests control. These schemes will make considerable demands upon engineering establishments. When they are complete, they will enable railways and private traders alike to get better value out of their rolling stock. More orders in certain branches of general engineering have involved the engagement of some additional labour. The last return showed a percentage of unemployment among engineers in the Midland Division of 20.9. A considerable reduction ought to be shown for the new year.

Coventry Engineering Prospects.

With the advent of 1923 reports as to the Coventry engineering trades are rather more encouraging. It will be recalled that the early days of last year gave rise to a certain amount of hope, which, however, was rendered null and void by the disastrous engineering lock-out, the evil effects of which have not yet been eradicated. The number of motor engineering concerns running additional shifts has recently increased, and with others a similar step is under contemplation. Barring disturbing influences, a fair seasonal trade for Coventry seems assured. The announcement that an important Coventry factory, at which the engines for two widely known light cars have been produced, has this year been taken over by the firm concerned, with a corresponding alteration of title, has aroused much local interest.

£10,000 Admiralty Order for Walsall

Considerable satisfaction was felt here when it became known this week that in connection with the construction of the two new battleships which have recently been ordered by the Government, a £10,000 contract for the making of naval tubes had been placed with a Walsall firm—the Talbot-Stead Tube Company, Birchills. It is stated that this order will find full time employment for 350 men for about three months.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER, Thursday.

General Conditions

THE improvement in the feeling with regard to the iron and metal trades is rather more obvious this week than it was last week, and, of course, one reason is that almost all the works have now resumed operations. There is certainly more business being done on the Manchester Exchange, and less disposition to accept new orders at the lowest prices of last year. In some departments there has been a distinct rise in the prices, but this is not universally the case; and if the general interests of trade are kept in mind there will be no desire to see any serious rise in the prices. A widening of demand is beginning, and this is what is wanted. It ought not to be checked by higher prices until all the works are fully employed. Both ironfounders and manufacturing engineers are better off for orders than they were during the greater part of last year, but there is still plenty of room for further expansion in these industries.

Copper.

The speculative market for standard copper has moved very little of late, and rather less interest is taken in it. Possibly any further improvement will have to wait until it is seen whether or not the slight revival in trade which has come with the New Year is to develop or to pass away again. The favourable feature in the copper market is the better position of best select ingot in relation to other kinds. This seems to indicate that the actual consumers of copper are buying more freely than they were. One may perhaps expect this freer buying to go on for a time, because it is clear that consumers do not now anticipate lower prices, and they will be the more inclined to hold larger stocks. A small increase in the stocks held by individual consumers makes a large difference to the producers, who are thus relieved from a heavy burden. The general consumption of copper may be expected to increase to a certain extent this year, and may equal the increase in the output; but the failure to reach agreement at the "Reparations" Conference may lead to a lessening, or even to a complete stoppage of the German demand. Last year this demand totalled over 120,000 tons, and was an important factor in preventing the collapse of American copper prices. If the French armies occupy the industrial centre of Germany it may have considerable effect upon German copper consumption. It would therefore be rash to assume that the copper market is to move upward without a check. The official prices for manufactured metal have not yet been altered. Strong copper sheets are quoted at £96 per ton, but Indian buyers can have 4ft. by 4ft. copper "braziers" at £82 10s. per ton. Tin has not yet fulfilled the expectations of those who looked for a £200 level. The highest price noted last year was £187 10s., and the lowest price £140 2s. 6d. per ton. The statistics of tin are fairly good, and one feature to be noted is the very large American consumption during last year. Some inroad has been made in the reserve stocks in the East; and if the consumption during 1923 is equal to that in 1922—as does not seem very unlikely—the market ought to be maintained at a fair level. Lead has kept very steady, and as time goes on and supplies to this country remain light, the expectation of lower prices fades. Lead prices are high compared with copper, but they are quite moderate when compared with spelter. The latter metal has been easier, but the prices quoted by British manufacturers of zinc sheets have not been reduced. It is perhaps worth notice that foreign sheet zinc can now be bought at favourable prices. There was an offer of Dutch sheets on c.i.f. terms at £41 per ton as against £45 for British zinc sheets.

Foundry Iron.

The market in Manchester for foundry iron remains very steady and firm. It cannot be said that iron is any dearer, but apparently complete confidence is felt that it is not going to be any cheaper in the near future. This confidence is shown first by the fact that Lancashire consumers seem quite willing to buy for their expected requirements up to the middle of the year at current

prices; and, secondly, by the absence of any disposition on the part of the merchants to "bear" the market. For nearly the whole of last year there was no opportunity for "bear" operations, simply because consumers were buying from hand to mouth; and now there is no inclination to sell forward and uncovered. On the other hand, makers of foundry iron are quite willing to contract up to June at current prices, say, 90s. to 91s. per ton delivered, so that they do not expect any rise in the price. The chances are for a steady quiet market during the next few months, with a slowly increasing consumption. Some North Lincolnshire iron is being offered here at about the same price as Derbyshire, and one or two more furnaces suitable for this district are expected to be put into blast. It is also expected that three or four more Cleveland furnaces will soon start on foundry iron, but apart from the indication that the trade of the country is improving, this will have little effect here. The business here in Scotch iron is still very much restricted because of the high price of that quality when delivered in Manchester.

Steel.

There is considerable strength in the finished steel market, and makers are quoting from 10s. to 12s. 6d. per ton more for plates and sections than they were before the holidays. Possibly this increase enables makers of Midland steel to work at a profit.

Scrap.

There is no doubt a better feeling in the market for scrap iron and steel, but in the case of foundry scrap there is too much offering for sale, and this checks a natural advance in the price. Dealers are trying to get 85s. for good broken machinery metal, but at present iron-founders can often come across cheaper parcels. More money is being paid here for heavy wrought scrap, and one hears of 75s. delivered in some cases. Melting steel scrap is worth 65s. on trucks in Lancashire.

Cheap Electricity.

In order to encourage advertising by electricity the Manchester Electricity Committee is seeking the approval of the City Council to a scheme under which it would offer a special inclusive rate of 1½d. per unit for shop window illumination after closing hours, with the stipulation that the earliest time of use will be after half-past five. No charge beyond the 1½d. per unit is proposed, because the department's fixed costs in regard to generating and distribution are met by the existing electricity business done with such premises, and the additional business would thus become a by-product. This new tariff will not apply to cinemas, places of entertainment, or "sky" signs. The Electricity Committee also considers that in view of the near completion of the Barton station an early start should be made in the conversion of the Dickenson-street power station to a a transforming station.

BARROW-IN-FURNESS, Thursday.

Hematites.

There is nothing to cloud the outlook in the hematite pig iron trade, and makers are experiencing better trade throughout the district. Quite apart from the business done in pig iron the local steel works are taking more, and practically every maker has the full output spoken for for some months. So good is business that there will be an addition of another furnace in the Cumberland district in the course of a week or so. Trade with the Continent continues to be brisk, and both Scotland and the Midlands are big customers. There is a much better tendency to order for forward deliveries, and many works are booked up for some months. The number of furnaces in blast in the North-West district is now eighteen, and if things continue to improve the twenty mark will soon be reached. Business in special qualities is better, and there is a healthy demand for manganese, spiegel, &c. Last week there was another shipment of pig iron to Philadelphia.

Iron Ore.

The iron ore mines are doing well, and many of the mines are working under almost normal conditions. Most of the ore is being used by local smelters, but a certain quantity is being sent out both by rail and coast-wise. Foreign ore is not being imported in quantities as yet, for stocks still remain at the docks. These stocks are, however, gradually being reduced.

Steel.

There is a fair amount of briskness in the steel trade at the moment, but it depends on further orders being booked in the immediate future if the works are to continue. Workington rail mills are now busy, but can only continue if further orders come to hand. The Barrow rail mills are perhaps a little better situated. The hoop mills are partially employed, and the foundries are experiencing a little better trade.

SHEFFIELD.

(From our own Correspondent.)

Position Still Improving.

THERE is continued progress in the revival of Sheffield industries, and all the signs which the New Year has so far presented go to confirm the feeling of optimism with which the Old Year closed. The improvement still relates especially to heavy steel, but it is also affecting the lighter branches in an increasing degree. The exports to the Dominions and several other overseas markets are growing at an encouraging rate. Trade with the Continent of Europe is still in a very backward state, which is not to be wondered at, considering the adverse rate of the exchanges. France, Belgium, Italy and Germany, although they are still buying Sheffield products, are confining themselves to necessities, and are not sending anything like the normal volume of orders. Even a partial rise in the value of European currencies would bring to Sheffield many orders for tools and tool steel.

Railway Material.

Railway material continues to be one of the most progressive and promising branches of the heavy steel trade. It would be a mistake to imagine that all the plants are busy, for they were so much extended during the war that it will need an enormous volume of work to keep them all fully employed. There are probably enough orders on hand now to employ the full capacity of the city as it was before the war, and further specifications continue to come in. The home railway companies are sending out, not only more, but also larger orders than they have distributed for a long time, and these contracts are being supplemented to an increasing extent by the placing of work for overseas markets, chiefly India and South America. These countries have latterly been going to Germany for a considerable part of their requirements, but considerations of the better quality of British materials, coupled with quicker delivery, are now telling in our favour. Pleasing evidence of the South American revival is afforded by the fact that during the past week Cammell Laird and Co., Limited, have received an order from the Central Argentine Railway Company for 200 all-steel bogie high-sided wagons and 140 all-steel bogie covered wagons. The order has been given to the Nottingham branch of the firm, but it will also be of benefit to Sheffield, where the steel work will no doubt be carried out. The quantity of work placed in this country by India, so far, is not as large as could be desired, but it is larger than some people expected. In order to attract trade, British firms have cut down prices to a very keen level.

Crucible Steel Improvement.

The crucible steel trade has been in a very depressed state for the last three years and is still very unsatisfactory; but it shows clear signs of revival. The home market is calling for larger supplies. There are no stocks on the hands of users, and as new machinery is brought into operation to deal with orders which they receive they are compelled to obtain more steel and tools. Sheffield crucible steel makers start the New Year with more numerous and valuable orders on hand than they have had in any month for a long period. The electrical branches are contributing largely to this better state of things. Important contracts for electrical machinery and apparatus in various parts of the world are being carried out by the British industry, which proves a good friend to the lighter side of the Sheffield steel trade, and also takes a very useful lot of castings and forgings. So far as the export side is concerned, the crucible steel trade is not yet showing any progress.

The New Warships.

Sheffield is rapidly putting its house in order for the production of the armour, guns, and other parts of the two new warships with which it has been entrusted. Vickers Limited have this week rolled the first armour plate for the deck of the new cruisers. The ingot weighed 27 tons, the weight of the rolled plate is 18 tons, and the weight of the finished plate will be 10 tons, as fitted to the ship. Besides the work that is done directly on the new vessels, Sheffield will have to do a great deal of an indirect character, in the supply of engineering tools and tool steel.

Cutlery and Plate.

Cutlery and electro-plate manufacturers have opened the New Year with a fair amount of work on hand, though the activity is not spread over all their departments. In cutlery the demand is still principally for stainless table knives, early supplies of which are wanted to replenish the stocks that were cleared out by the Christmas sales. There is a brisker demand from overseas markets. Prices are kept very low by competition, however, and there is not a great deal of profit in the trade. In other sections Sheffield cutlery is still severely hit by German competition, and there are large stocks of imported goods in the hands of British distributors. The falling off in the demand for razors has been so great that some firms have stopped production. The electro-plate industry is very busy with spoons and forks, especially those of the new nickel alloy with its valuable stain-resisting qualities. In regard to hollow-ware, the year has opened more favourably than was the case twelve months ago.

Hull Tram Rails.

I have referred on more than one occasion to an order for 1000 tons of tramway rails which the Hull Corporation is desirous of placing, and to the efforts which have been made to obtain a reduction of price in order that the work might be kept in this country. The matter is still not finally settled, but it does not seem likely that the contract will be given to any British firm. The Hull authorities decided to re-advertise for tenders, but instead of British prices going down they have now gone up. Steel, Peech and Tozer, Limited, of Sheffield, who submitted the lowest home tender, now ask £14,330, as compared with the £11,750 which they offered three months ago, and the Cargo Fleet Iron Company quotes rather more. Against these tenders are two from the Continent which show a great difference in price, one from the Anglo-Belgian Improvements Corporation at £9547 10s., and the other from the Phœnix Equipment and Engineering Company, for German rails, at £9613. The Tramways Committee has recommended the acceptance of the Belgian tender, which is no less than £4782 10s. lower than that from Sheffield. Inquiries have been made among Sheffield manufacturers as to their views on the reason for this great difference, and several opinions have been put forward. It is suggested that Belgium has a much cheaper supply of raw material than this country, and is getting heavy deliveries from Germany at very favourable rates. There is the possibility that the Belgian firm is subsidised by the Government. The state of the exchanges must be taken into account, and it is also urged that wages are lower in Belgium than in this country, and that the workmen there are showing increased energy and turning out more work per man. Another factor, which probably has an important bearing on the matter, is the handicap of high railway rates from which British trade suffers, while high local rates form another serious consideration.

Electric Progress.

The Electricity Department of Sheffield Corporation confirms the reports of the improving state of trade. It has laid itself out especially to supply current to works, and it finds that larger supplies are now being needed for electric furnaces, and also for rolling mills, which are being gradually converted from steam to electric drive. The department looks forward optimistically to the next twelve months. While it will not be in need of any extension of capacity during that period, it is probable that, before this year is out, preliminary steps will have to be taken in connection with the erection of a new station of 60,000 kilowatts, which has been projected for some time. There is a rapid increase in the use of electricity for domestic purposes, both lighting and cooking, and on the whole it is expected that, when the financial year ends in March, the department will be able to show an advance in the number of units sold of about 12 per cent. as compared with the previous year. The prices of electricity in Sheffield two years ago were 150 per cent. above the pre-war standard, but there have been three reductions, and the addition is now 75 per cent. Rotherham Corporation has decided to reduce its charges for electric power to manufacturers, the tramways undertaking, and to cinematograph entertainments, from 100 per cent. above pre-war to 75 per cent. This will mean a loss to the revenue of £28,000. There is also to be a reduction in the price for traction, from 1.8d. to 1.6d., which will represent £1800 less revenue. No reduction for lighting is proposed.

The Telephone System.

Sheffield has recently been much exercised by the delay in the erection of its new Central Automatic Telephone Exchange. The foundations of the building were laid some months ago, but then work came to a standstill. At the request of the Parliamentary Committee of the City Council, Colonel H. K. Stephenson has approached the Postmaster-General on the matter. He has now received a reply, stating it is hoped to proceed at an early date with the erection of the steel framework, tenders for which are now under examination, and that the details of the contract for the main structure are being pressed forward. The Postmaster-General states that the urgency of the scheme is fully recognised, both by the Post Office and by the Office of Works. He adds that arrangements for the provision of the Owlerton and Sharrow exchanges are well in hand, and that it may be anticipated that they will be available as soon as, if not earlier than, the Central Exchange.

NORTH OF ENGLAND.

(From our own Correspondent.)

Cleveland Iron Trade.

THE position in the Cleveland iron trade continues to move on encouraging lines, and confidence in the outlook is increasing. There is, of course, nothing in the nature of a boom expected, but trade is broadening out, and as it tends to expand in all directions, more blast-furnaces are likely to be put into operation very soon. The reparations crisis and the fall in the exchanges seriously handicap continental business, which had been showing signs of improvement, but the volume of home trade is steadily increasing. The steel works are needing more iron, the foundries are busier, and the current output of foundry iron is now no more than sufficient to meet requirements. The improvement in the Scottish trade is marked, but in other directions also there is a better demand. No. 1 Cleveland foundry iron remains at 96s. 6d., and No. 3 G.M.B. Cleveland at 92s., but No. 4 foundry is rather slow of sale, and in the hope of stimulating the demand, makers are selling at 85s. per ton. No. 4 forge remains unchanged at 82s. 6d., and mottled and white 80s. per ton.

Hematite Pig Iron.

There are now fourteen blast-furnaces producing East Coast hematite pig iron, and the output is practically all going into prompt consumption. Makers have small stocks, but the reserves are not large, and any increased demand would necessitate more furnaces being lighted. A little iron is going to Italy, but the export trade is very small, and makers are relying chiefly on the home demand. Mixed numbers are firm at 93s., and No. 1 at 93. 6d. per ton.

Iron-making Materials.

Sellers of foreign ore are now exacting higher rates, contending that recent sales have been below cost. The price of best Rubio ore is now fully 23s. per ton c.i.f. Tees. The price of fuel shows no signs of weakening, and ironmasters are gravely concerned. Generally 31s. per ton delivered at the works is quoted for good medium furnace coke, but there have been sales at 30s.

Manufactured Iron and Steel.

Further encouraging accounts are given of the manufactured iron and steel trade. Most of the works have fairly satisfactory order books, and inquiries are increasing. Makers are consequently not now inclined to cut, and prices all round seem to be much firmer.

The Coal Trade.

The Northern coal trade is generally very steady all round, with a fairly healthy outlook ahead, providing the foreign atmosphere begins to clear. Just now business is temporarily held in abeyance, pending the result of the Paris Conference; but when the reparations question is satisfactorily settled, trade is likely once more to move

forward. The home trade is rather heavier, and there is a number of large industrial contracts either under discussion or in preparation. The export trade seems to give promise of a gradual expansion, and, as a rule, the market is strengthening, and the ideas of shippers are moving upward in regard to the price for nearly every kind of coal. There is a fairly heavy general inquiry from France and Italy, and advices from Germany indicate that, in addition to their current inquiries, there are others in preparation, which will be of some assistance to the export trade. The strike at Antwerp is hampering shipments to Belgium, but it is hoped that a speedy settlement may be effected. There are conflicting reports in circulation regarding the possibilities of American business. Undoubtedly, there are some orders in the preliminary stages of negotiation, but so far only a very few have actually been booked. A number of Northern exporters are of the opinion that Cardiff will probably succeed in capturing the bulk of the business for the United States. During the past few days the Northumberland steam coal section has made progress consistently, so that for any brand of Blyth and Tyne best screened steams, holders are indicating the colliery quotations, and even then supplies are running short. Second screened and unscreened are also firmer, with smalls very strong for every class. Durham coals are very stiff for every sort. Wear special and prime gas are very scarce and at top values every time, while better prices are obtainable for any good brand second, gas, coking or the usual bunker sorts. Coke continues to be very steady. Best beehive and patent oven coke make good prices, while gas makes are also scarce and firm.

Blast-furnacemen's Wages.

The ascertainment for the past quarter issued by the Cleveland Ironmasters' Association certifies that the average net selling price of No. 3 Cleveland pig iron, was 88s. 4.74d. per ton, an advance of 2s. 9.58d. per ton, as compared with the price for the preceding quarter. In accordance with the sliding scale arrangement there will be an advance in blast-furnacemen's wages of 2.75 per cent., which will raise them to 26.75 per cent. above the standard. The advance takes effect from Monday last.

New Limestone Quarries.

Bolckow, Vaughan and Co., Limited, of Middlesbrough, have acquired an extensive limestone area in the Manor of Hartley, near Kirby Stephen, Westmorland, with a view to quarrying limestone on a large scale. Some little time must elapse before working operations begin. The area acquired consists of a large tract of high-lying land in the north-eastern corner of the Manor, and lies east of the London and North-Eastern Railway, which will afford excellent transport facilities. There are several old lead mine workings within the area, but it is understood that Messrs. Bolckow, Vaughan and Co. have acquired only the limestone royalty rights.

Ironstone Miners' Hours and Wages.

The Cleveland ironstone mineowners have granted a 2 per cent. increase in wages to the miners, though with some reluctance. Before the war the miners were paid 5 per cent. on the base rate more than they would have been entitled to had wages been calculated strictly upon the ascertained selling prices of pig iron. That advantage was afterwards increased to 15 per cent., and it was because the miners had been enjoying this benefit for some time that the owners were reluctant to make any advance. No settlement has been reached on the question of increased working hours suggested by the owners, the problem being referred for further consideration to a joint committee.

SCOTLAND.

(From our own Correspondent.)

A Holiday Week.

THE past week has been practically a blank owing to the New Year holidays. Business has been more or less at a standstill and markets have not been tested.

Brighter Prospects.

As I write, industrial establishments are opening up and producers are making ready to cope with the bigger demand expected. General orders have been more numerous of late and there has been more inclination on the part of consumers to anticipate requirements. The talk of higher prices will no doubt induce some to arrange supplies at once. Very little actual business has been done, however, as makers have long been complaining of unremunerative prices and are not likely to lose any opportunity for sharing in higher quotations. So far as the year has gone the tendency of the markets is certainly in an upward direction. It is hoped that the increase in business will affect production sufficiently to reduce overhead charges to an extent likely to check any serious rise in values. Meantime home demands are much more promising than they have been for at least twelve months, and export business also shows a tendency to expand.

Edinburgh Supports Home Industry.

Last week the Edinburgh Town Council decided to place a contract for 2000 tons of tramway rails and 100 tons of fish-plates with a Middlesbrough firm, whose tender was almost £5000 higher than the lowest offer received. The Middlesbrough tender worked out at £9 9s. per ton, while the Belgian offer referred to showed a cost of £7 15s. per ton. Carrying this policy a stage further, the same Council also decided to place an order for car top covers with an Edinburgh firm, whose offer was some £1200 above the lowest offer from a Sheffield firm.

Emigration.

Many workers, chiefly engineers and shipyard workers, have left the Clyde area during the trade depression, and many are still going. Engineers' wages are still very low in this area, in many cases being little over £2 15s. per week. In some instances labourers in the same district are receiving better wages. It is said that many of the emigrants intend to go to America or Australia. It is calculated that somewhere between 1000 and 2000 men have left this district already.

Steel, Iron and Coal.

The majority of the steel and ironworks have resumed operations, the stoppage being of shorter duration than was expected a few weeks ago. Owing to recent shipbuilding orders the steel works have had better inquiries, and some establishments already have a fair tonnage on hand, both for plates and sectional material. Steel sheets, too, have experienced a better all-round demand of late. The bar ironworks are beginning to feel some benefit from orders placed in the district and the outlook is more hopeful. Orders for re-rolled steel bars are also more plentiful, while wrought iron is sharing in the increased demand. Tube makers are busy and the inquiry for strips is larger accordingly. As already stated, all prices are firm, with a decidedly upward tendency. Business in the coal market has been very limited. Both buyers and sellers have been acting cautiously. The export demand dropped a little before the end of the year, but this was thought to be only a temporary lapse caused by the approach of the holidays. The collieries have still a considerable amount of shipping orders to fulfil, but there is certainly a tendency in some quarters to quote easier prices in order to augment the January sales. Already there are indications of a better home industrial turnover, while the household demand is larger than for some months back. Aggregate shipments for the week amounted to 134,325 tons, against 284,352 tons in the preceding week and 78,544 tons in the same week last year.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Position.

THE conditions prevailing in the steam coal trade are not by any means as satisfactory as they might be. The market for prompt loading, instead of being firm, as was anticipated would be the case, is easy, and prices are irregular, but as most exporters made their arrangements for supplies a little while ago, there are very few firms who are able to take advantage of the situation. The fact of the matter is that tonnage is none too plentiful. For about two months the docks have been congested, and it is not infrequently the case that these conditions are followed by a scarcity of steamers. Shipowners have undoubtedly had a very bad time owing to the abnormal amount of detention, and the consequence is that many owners are giving this channel a wide berth for a time at least. On top of this the very bad weather at sea has caused tonnage to get out of position, and numerous steamers coming to hand have sustained damage necessitating repairs. The result is that the amount of ready tonnage to load is short of requirements, and as collieries have difficulty in getting the release of wagons, coals for spot loading are weak, but for forward shipment coal-owners have very different ideas, as they expect that before very long tonnage will arrive up together and there will be a recrudescence of heavy loading pressure. At the moment the demand from Italy and France is rather quiet, and it is likely that the fluctuating conditions of the foreign exchanges will have a prejudicial effect upon business. In the case of America, quite a good deal of tonnage has been chartered for the North American range of ports at rates varying from 7s. 6d. to 9s. 6d. f.d., and there is still a good inquiry, but there is not much fresh inquiry coming along from the States, and it looks as if importers are not disposed to operate at the increased prices which are being quoted. The freight market has rather weakened, and it is not likely that shipowners can get more than 9s. to 9s. 3d., but it is very much to be feared that firms who have so far accepted business for America and have had to pay the foregoing rates of freight have made nothing out of the business in the way of a profit, as there is reason to believe that most people based on a a rate of about 7s. 6d. when they put in their prices for the business.

Docks Working Conditions.

On Thursday of last week there was a conference of all the interests concerned to consider the question of dock delays. Mr. J. H. Vickery, the chief docks manager under the Great Western Railway Company, put the case for the employers and gave a statement regarding the delays which were being experienced, and in view of the facts presented he urged that there should be established a system of extended hours of work. The workmen's leaders pointed out that it would be necessary that there should be a joint committee to investigate all the facts and report back to the conference, as the workmen were not prepared to discuss the principle until the facts had been agreed upon. The employers recognised the reasonableness of this suggestion, and agreed to it on the understanding that there was no unnecessary delay, as the matter is one of urgency. The result was that it was decided that a committee consisting of six representatives from each side should be appointed, and this committee will proceed with its work forthwith.

Waiting Time.

Not so long ago the trimmers at the docks here decided that they would not wait longer than two hours for supplies of coal unless they were paid waiting time. At the end of last week trimmers engaged on the ss. Inston at the Penarth docks put the decision into practice, and the result is that the case is being taken up by the employers, and it is to be brought to the notice of the National Trimming Board in London, inasmuch as the trimmers' local representatives have declined to discuss the matter. Details of the case show that the ss. Inston was in berth at the Penarth docks at 6.50 a.m. on Thursday morning in last week, and commenced on bunkers. There were four trimmers engaged at the commencement, but only three of them continued to work. At 8.20 a.m. the steamer was in berth for taking cargo, but at 12.20 supplies of coal ran out. The actual earnings of the trimmers on the first shift worked out at £1 15s. 2d. per man, or 5s. 10d. per man per hour. The next gang came on at 2.30, and when they knocked off at 4.40 there was one wagon on the tip and other coal was near at hand, but they would not wait any longer than the two hours they had been waiting for coal, notwithstanding that the whole of the coal required for the steamer would have been down in time to have enabled the steamer to have completed that night. Had the trimmers stopped on the second shift to work it is estimated that their earnings would have worked out at £3 13s. 6d. per man, or 9s. 2d. per man per hour. The effect of the trimmers' action was that the ss. Inston, which is on time charter, was kept until Friday morning to finish taking her cargo. As a matter of fact, she did not complete until one o'clock on the Friday, which meant that a second steamer for which arrangements had been made to commence loading in the same berth as the ss. Inston first thing on Friday could not do so. Instead of finishing her cargo on the Friday, her loading ran over to the Saturday and a third steamer, which should have made a commencement in the same berth on the Saturday morning, could not do so until Monday. Thus it will be seen how the detention suffered by one steamer affects adversely the loading of other tonnage. As regards the claim of the trimmers to be paid waiting time, the reply of the shipowners is that this matter was taken into account when the tariff for the trimmers was fixed.

South Wales Steel Works.

The report is current that Messrs. Guest, Keen and Nettlefold intend laying down at considerable expense a substantial amount of new plant at their works at Dowlais. With regard to the Ebbw Vale steel works, the chairman of this company has expressed the opinion that it will not be before March that a re-start can be made, as there is so much preliminary work to be done.

Mechanical Appliances.

It is reported that in the Rhondda hundreds of miners have received fourteen days' notice, these men being engaged at the Glamorgan, Cambrian and Naval Collieries. The men contend that this state of things has been brought about by the introduction of conveyors at the collieries. The district committee of the miners has instructed the Executive Council of the Federation to call a special conference to discuss what is described as a serious situation.

New Industry.

The Mayor of Newport has received from a London firm an inquiry which may possibly result in a new industry for that town. The letter in question has been handed to the Development Association. The firm, viz., Imex, Limited, of Devonshire-square, Bishopsgate, state that it intends erecting tanks for the storage of petrol, the ultimate object being the building of a crude oil refinery. Two acres of land will be required, as flat as possible, with hard subsoil near the water front, with railway connection or a railway running close by. The company states that in view of possible extensions at a later date they would like to have the option of four to six acres of adjoining land, which option could be exercised in two or three years' time.

Current Business.

The tone of the market is at the present time rather quiet and there is not a great deal of fresh inquiry coming forward. Although colliery salesmen are in a general way quoting 28s. to 29s. for the best Admiralty large coal, they are prepared to accept about a shilling less for spot shipment, as many of the collieries are hard pressed to maintain their supply of empty wagons to enable the collieries to keep working. The market is generally patchy, but small coals are very steady, as the working of large coals is not so active. Patent fuel is very scarce, as makers are experiencing much difficulty in getting pitch supplies. This commodity is so dear, as well as being scarce, that manufacturers are only purchasing sufficient supplies of pitch to enable them to manufacture the quantity of patent fuel that they have got sold.

Latest News from the Provinces.

WALES AND ADJOINING COUNTIES.

Swansea Metal Exchange.

The tin-plate market is firm as the result of a better inquiry for export. Manufacturers are declining to sell at less than 21s. basis I.C. f.o.b., as tin-plate bar makers are quoting from 5s. to 7s. 6d. per ton more for bars in the expectation that the official price for bars will shortly be raised.

Dowlais Steel Works Developments.

With regard to the developments reported at the Dowlais works, it is now stated that the contract has been let for a large new electrical plant, and that tenders are under consideration for a new set of coke ovens. The constructional work will take about twelve months.

New Swansea Works.

Although the construction of the bridge and structural engineering works of Sir William Arrol and Co. (Swansea), Limited, only started last June, manufacturing has already commenced, and hopes are entertained that before long 500 men will be employed. The works are in course of erection at Crymlyn Burrows, Swansea, near the tin-plate works of Baldwins, Limited, and occupy a site of about 12 acres.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
Native	22/6
(1) Spanish	22/6
(1) N. African	22/6
N.E. COAST—	
Native	—
Foreign (c.i.f.)	23/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	5 7 6	—
No. 1 Foundry	5 0 0	—
No. 3 Foundry	4 15 0	—
N.E. COAST—		
Hematite Mixed Nos.	4 13 0	4 13 0
No. 1	4 13 6	4 13 6
Cleveland—		
No. 1	4 16 6	4 16 6
Silicious Iron	4 16 0	4 16 0
No. 3 G.M.B.	4 12 0	4 12 0
No. 4 Foundry	4 5 0	4 5 0
No. 4 Forge	4 2 6	4 2 6
Mottled	4 0 0	4 0 0
White	4 0 0	4 0 0
MIDLANDS—		
(3) Staffs.—		
All-mine (Cold Blast)	13 0 0	—
North Staffs. Forge	3 15 0	—
,, ,, Foundry	4 5 0	—
(3) Northampton—		
Foundry No. 3	4 0 0	—
,, Forge	3 11 0	—
(3) Derbyshire—		
No. 3 Foundry	4 2 6 to 4 3 6	
Forge	3 13 6	—
(3) Lincolnshire—		
Basic	4 0 0	—
Foundry	4 2 6 to 4 3 6	
Forge	4 0 0	—
(4) N.W. COAST—		
N. Lancs. and Cum.		
Hematite Mixed Nos.	5 10 0	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	10 10 0	10 10 0
Best ,,	12 0 0	—
N.E. COAST—		
Crown Bars	10 10 0	—
Tees	10 0 0	—
LANCS.—		
Crown Bars	11 10 0	—
Second Quality Bars	10 5 0	—
Hoops	14 0 0	18 15 0
S. YORKS.—		
Crown Bars	11 10 0 to 12 0 0	
Best ,,	12 10 0	—
Hoops	14 0 0	—
MIDLANDS—		
Crown Bars	10 10 0 to 10 15 0	
Marked Bars (Staffs.)	13 10 0	—
Nut and Bolt Bars	9 12 6 to 9 15 0	
Gas Tube Strip	10 15 0 to 11 0 0	

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates	12 0 0	—
Ship Plates ⅜in. and up	8 15 0	—
Sections	8 7 6	—
Steel Sheets ¼in. to ½in.	10 10 0	—
Sheets (Gal. Cor. 24 B.G.)	—	17 10 0

STEEL (*continued*)

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	9 0 0 to 9 10 0	—
Angles	8 15 0 to 9 0 0	—
Boiler Plates	12 10 0	—
Joists	9 0 0	—
Heavy Rails	9 0 0	—
Fish-plates	13 0 0 to 14 0 0	
Channels	13 10 0	—
Hard Billets	8 15 0	—
Soft Billets	8 0 0	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 15 0	—
Light ,,	9 15 0 to 10 5 0	
Billets	8 15 0	—
MANCHESTER—		
Bars (Round)	9 0 0 to 9 10 0	
,, (others)	9 10 0 to 10 0 0	
Hoops (Best)	15 5 0	15 0 0
,, (Soft Steel)	12 5 0	12 0 0
Plates	9 0 0 to 10 0	
,, (Lancs. Boiler)	13 10 0	—
SHEFFIELD—		
Siemens Acid Billets	10 0 0	—
Bessemer Billets	12 10 0	—
Hard Basic	8 15 0	—
Intermediate Basic	8 10 0	—
Soft Basic	7 15 0	—
Hoops	12 10 0 to 13 0 0	
Soft Wire Rods	10 0 0	—
MIDLANDS—		
Small Rolled Bars	9 10 0 to 9 15 0	
Billets and Sheet-bars	7 7 6 to 7 10 0	
Gas Tube Strip	10 0 0 to 10 5 0	
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets (f.o.b. L'pool)	17 5 0 to 17 10 0	
Angles	9 0 0	—
Joists	9 0 0	—
Tees	10 0 0	—
Bridge and Tank Plates	9 10 0 to 9 15 0	

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	20/6 to 21/-
Block Tin (cash)	179 2 6
,, (three months)	180 12 6
Copper (cash)	64 7 6
,, (three months)	65 0 0
Spanish Lead (cash)	26 12 6
,, (three months)	26 5 6
Spelter (cash)	35 10 0
,, (three months)	34 0 0
MANCHESTER—	
Copper, Best Selected Ingots	69 10 0
,, Electrolytic	72 0 0
,, Strong Sheets	96 0 0
,, Loco Tubes	0 1 1½
Brass Loco Tubes	0 0 11½
,, Condenser	0 1 1½
Lead, English	28 0 0
,, Foreign	27 0 0

FERRO ALLOYS.

(All prices now nominal.)

	Per Ton.	Per Unit
Tungsten Metal Powder	1/11 per lb.	
Ferro Tungsten	1/5 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£23	10/6
,, 6 p.c. to 8 p.c. ,,	£21 0 0	8/-
,, 8 p.c. to 10 p.c. ,,	£20 0 0	8/-
,, Specially Refined		
,, Max. 2 p.c. carbon	£54 0 0	20/-
,, ,, 1 p.c. ,,	£64 0 0	22/6
,, ,, 0·75 p.c. carbon	£72 0 0	25/-
,, carbon free	1/7 per lb.	
Metallic Chromium	4/9 per lb.	
Ferro Manganese (per ton)	£15 for home.	
,, Silicon, 45 p.c. to 50 p.c.	£11 2 6 scale 5/- per unit	
,, ,, 75 p.c.	19 10 0 scale 6/- per unit	
,, Vanadium	17/- per lb.	
,, Molybdenum	9/6 per lb.	
,, Titanium (carbon free)	1/2 per lb.	
Nickel (per ton)	£160	
Cobalt	11/- per lb.	
Aluminium (per ton)	£82 to £100	

(British Official.)

FUELS.

SCOTLAND.

		Export.
LANARKSHIRE—		
(f.o.b. Glasgow)—Steam		22 6
,, ,, Ell		23/3
,, ,, Splint		24/- to 25/6
,, ,, Trebles		23/6
,, ,, Doubles		21/6
,, ,, Singles		16/-
AYRSHIRE—		
(f.o.b. Ports)—Steam		22/6
,, ,, Splint		24/-
,, ,, Trebles		23/6
FIFESHIRE—		
(f.o.b. Methil or Burntisland)—Steam		21/6 to 23/9
Screened Navigation		23/-
Trebles		24/-
Doubles		21/9
Singles		17/-
LOTHIANS—		
(f.o.b. Leith)—Best Steam		23/-
Secondary Steam		23/-
Trebles		22/9
Doubles		22/-
Singles		16/9

ENGLAND.

(8) N.W. COAST—	
Steams	29/6
Household	46/6 to 57/6
Coke	34/-
NORTHUMBERLAND—	
Best Steams	24/6 to 25/-
Second Steams	21/6 to 22/6
Steam Smalls	13/- to 15/-
Unscreened	20/6
Household	25/- to 28/-
DURHAM—	
Best Gas	24/- to 25/-
Second	22/- to 23/-
Household	25/- to 28/-
Foundry Coke	37/- to 40/-

SHEFFIELD—	INLAND.
Best Hand-picked Branch	32/6 to 34/6
Barnsley Best Silkstone	23/- to 30/-
Derbyshire Best Brights	24/- to 26/-
,, ,, House	21/6 to 22/6
,, ,, Large Nuts	19/6 to 22/6
,, ,, Small ,,	15/- to 16/6
Yorkshire Hards	20/- to 21/-
Derbyshire ,,	19/- to 20/6
Rough Slacks	9/- to 11/-
Nutty ,,	7/9 to 9/9
Smalls	3 - to 5/-
Blast Furnace Coke (Inland and Export)	21/- to 30/-

(9) SOUTH WALES.

CARDIFF—	
Steam Coals:	
Best Smokeless Large	28/- to 28/6
Second ,,	27/- to 28/-
Best Dry Large	27/- to 28/-
Ordinary Dry Large	26/- to 27/-
Best Black Vein Large	27/- to 27/6
Western Valley ,,	26/6 to 27/-
Best Eastern Valley Large	26/6 to 27/-
Ordinary ,, ,,	24/- to 26/-
Best Steam Smalls	18/- to 18/6
Ordinary ,,	15/- to 17/6
Washed Nuts	27/6 to 37/6
No. 3 Rhondda Large	29/- to 31/-
,, ,, Smalls	19/- to 21/-
No. 2 ,, Large	24/- to 25/-
,, ,, Through	19/6 to 22/6
,, ,, Smalls	14/- to 15/-
Coke (export)	40/- to 45/-
Patent Fuel	32/6 to 34/-
Pitwood (ex ship)	30/- to 31/-
SWANSEA—	
Anthracite Coals:	
Best Big Vein Large	32/6 to 35/-
Seconds	30/- to 32/6
Red Vein	28/- to 29/-
Machine-made Cobbles	42/6 to 45/-
Nuts	55/- to 57/6
Beans	42/6 to 45/-
Peas	22/- to 23/-
Breaker Duff	11/- to 11/6
Rubbly Culm	14/- to 14/6
Steam Coals:	
Large	25/- to 26/-
Seconds	23/- to 25/-
Smalls	10/- to 12/-
Cargo Through	17/- to 20/-

(1) Delivered. (2) Net Makers' works. (3) At furnaces. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—F.O.B. Glasgow.

(8) Except where otherwise indicated coals are per ton at pit for inland and f.o.b. for export and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b.

French Engineering Notes.

(From our Correspondent in Paris.)

The Outlook.

THE rupture of the Paris Conference has modified the situation to a degree that may have considerable consequences for the metallurgical and engineering trades, but the nature of those influences must obviously depend upon the results that will follow the drastic measures which it is proposed to carry out for the recovery of reparations. The main factor is that the occupation of the Ruhr is expected to provide an abundance of coke for the Lorraine blast-furnace proprietors, who have for many months past found themselves in a very precarious situation through the dwindling coke supplies. The dependence of Lorraine on the Ruhr is so complete that its existence is menaced by the failure of Germany to provide the required quantity of coke. The French firmly believe that their occupation of the Ruhr Basin will enable blast-furnace owners in the restored province to develop considerably their production of pig iron and bring down prices to a level that will place the metallurgical and engineering trades in a far better position than they are now. Whether or not these expectations will be shattered by economic and labour troubles in the Ruhr can hardly be foreseen in the present state of affairs; but even admitting that the occupation will proceed smoothly, and that sufficient quantities of cheap coke will be available, it has still to be seen whether producers will be able to dispose of their larger and cheaper supplies of semi-manufactured steel. At present the great bulk of the iron ore and steel is going to Germany, and if for some reason, such as a complete German collapse, the material should remain in French hands, the situation of the metallurgical trades will either be worse than it is now or producers will have to find new outlets, which may mean a formidable price cutting in foreign markets. It should not be overlooked that with ample supplies of coal and coke France would possess all that is necessary to become the biggest iron and steel producer in Europe.

State Alcohol Control.

If there were anything which might appear to justify the intervention of the State in industrial matters it would be the organisation of power alcohol distribution. So long as beet growers in the north and viticulturists in the south were in conflict, and the prices of alcohol were constantly fluctuating, there could be no stability without some central control, and by a law passed in 1916 the State was granted a monopoly until September, 1924, of the purchase and distribution of power alcohol, that is to say, alcohol produced from beet, grain and other produce, except grapes and fruit. The object of this monopoly was to provide consumers with alcohol at the lowest possible price. Unfortunately, the State has not been able to dispose of the alcohol at the same rate as it purchased it at, with the result that it has now stocks amounting to nearly 32,000,000 gallons and credits have had to be obtained for the construction of additional storage tanks. As the State cannot continue to store a product which it is unable to sell, the Minister of Finance has adopted the expedient of reducing the purchase price to a figure which producers affirm is below the cost of production. Consequently, some of the large grain distilleries are said to be on the point of closing down, and the State monopoly is therefore proving disastrous to an important industry which, had it been free to do so, would probably have found outlets for its production of alcohol. The Bill to be introduced into Parliament requiring importers of petrol, benzol, benzine and other motor fuels to purchase alcohol for mixing in the ratio of 10 per cent. of the quantity of motor spirit brought into the country is obviously intended as a means of reducing these huge stocks.

Railway Construction.

The Superior Council of Railways has approved of the carrying out of works during the present year involving an expenditure of 775 million francs on permanent way and other constructions and 270 million francs on electrification. Nearly one-half of the latter amount will allow the Midi Company to complete the first part of its programme, including the utilisation of the hydraulic resources of the Ossau Valley and the electrical installation of new lines which will bring up the total to 1500 kiloms., or one-half of the programme approved of in 1920. Of the 90 million francs authorised to be spent by the Paris-Orleans Company upon electrification only a small amount will be used for the construction of generating stations, as such work will be undertaken by private companies in which the Paris-Orleans Company is interested, and most of the energy will be supplied from the Upper Dordogne. Emergency supplies of current will be furnished by the generating stations in the Paris district. It is expected that the line between Paris and Vierzon will be completely electrified during the present year. On the State railways the electrification is limited for the moment to the Paris suburbs. The P.L.M. Company is only electrifying the line between Culoz and Modane with energy supplied by private companies, while other lines will be electrified eventually on the Riviera. The other works consist largely in the reconstruction and extension of stations, especially on the Nord, and in doubling existing lines, while a certain sum is to be devoted to "works of security."

Loss of Foreign Trade.

Sugar machinery firms did a large amount of business before the war with Cuba, Argentina and other Central and South American countries, but the business has now passed into the hands of United States manufacturers, and the French firms are unable to get any of it back. Were it not for the work of reconstructing sugar factories in the devastated regions they would, in fact, find themselves without orders at all. The situation appears incomprehensible to makers here, who had thought that the advantage of the exchange rate would have enabled them to secure business in South America. The plants laid down by United States firms are, however, of considerably greater capacity than those previously installed by the French.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

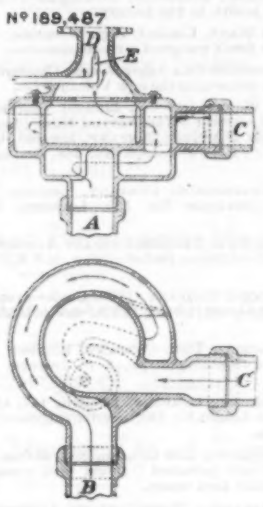
The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

INTERNAL COMBUSTION ENGINES.

189,487. July 27th, 1921.—CARBURETTERS, A. A. Magen, Jardin Botanique de Saigon, Cochin China.

THIS device is really an adjunct to the ordinary carburetter and is intended to improve the gasification of the heavier oils in the fuel. It comprises a casing which is heated by the exhaust gases supplied at A and discharged to the atmosphere at B. The combustible charge is admitted at C and delivered to the engine

N° 189,487.

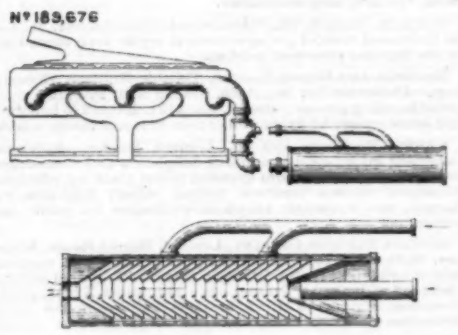


by the outlet D. The charge is given a whirling movement by the shape of the chamber, which projects the heavier oils against the heated walls, and they are thereby gasified. At the same time the lighter fractions of the charge pass directly to the outlet. E is a jet for supplying a light spirit when starting the engine.—*November 27th, 1922.*

189,676. January 3rd, 1922.—SILENCERS, T. Reynolds, 3118, St. Dominique-street, Montreal, Canada.

This silencer comprises a series of cones, arranged in a casing, through the middle of which the exhaust gases are discharged. A branch is taken off the main exhaust pipe, as shown in the

N° 189,676

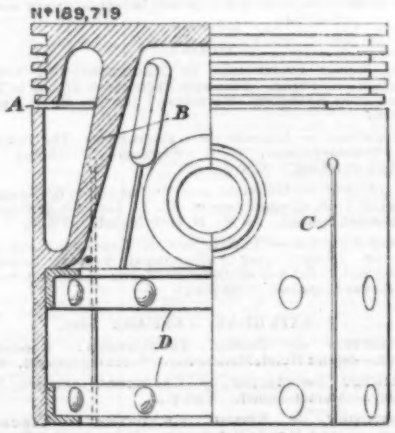


general arrangement, and is led to one or two openings in the silencer casing. The ejector action of the main exhaust through the centres of the cones has the effect of inducing a flow through the branch pipe. The cones are held in place by being threaded on to rods.—*December 7th, 1922.*

189,719. May 12th, 1922.—PISTONS, D. Napier and Son, Limited, and H. C. Tryon, 211, Acton-vale, London, W. 3.

In this piston, which is of the type having a head and skirt

N° 189,719



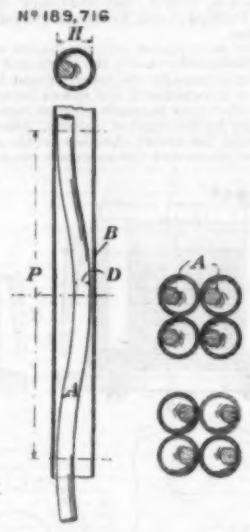
separated by a circumferential cut A, but connected together by the trunk B, knocking is minimised by splitting the skirt, as shown at C, and inserting one or more rings D. These rings are made of such a material that their expansion corresponds with that of the cylinder liner and thus maintains the proper clearance between the piston and cylinder.—*December 7th, 1922.*

TELEGRAPHS AND TELEPHONES.

189,716. April 22nd, 1922.—IMPROVEMENTS RELATING TO TELEPHONE CABLES, Johnson and Phillips, Limited, and George Charles Peason, both of Victoria Works, Charlton, S.E. 7.

In ordinary and in phantom circuit working it is important that there shall be the minimum out-of-balance and equal wire-to-wire capacity between the conductors. For this purpose it is necessary that the mean distance between the centres of the conductors forming pairs and between the centres of any two conductors in a quad, or in a two-pair core, shall be as equal as possible, and that these distances apart shall be uniformly

N° 189,716

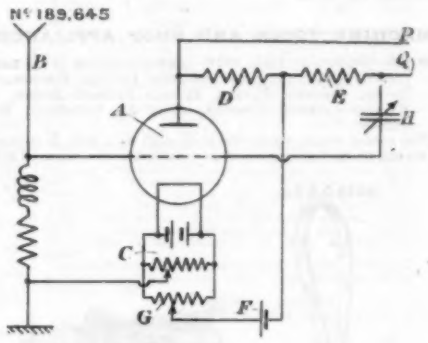


maintained. According to this invention, the wire conductors are twisted into a helix of relatively large pitch, the outside diameter of the helix being approximately equal to the distance which it is desired to have between the axes of the conductors. A is the conductor twisted into a helix of which the pitch P is about twenty times the diameter D of the conductor, and the diameter H of the helix is about twice that of the conductor. B is the paper tube.—*December 7th, 1922.*

189,645. December 1st, 1921.—IMPROVEMENTS IN WIRELESS TELEGRAPH RECEIVERS, Laurence Beddome Turner, of 61, Bateman-street, Cambridge.

The object of this invention is to minimise disturbances caused by atmospherics. In the diagram A is the triode of the limiter amplifier, its grid being connected to the antenna B and its main potential is controlled by the potentiometer C. D and E are two equal impedances, their junction being controlled in main potential by the battery F and the potentiometer G. H is the

N° 189,645



balancing condenser, adjustable over values of capacity in the neighbourhood of the capacity between the grid and the anode of the valve A. P and Q are the output terminals of the limiter amplifier, across which the limited fluctuations of potential difference occur. It is undesirable to connect to either of the terminals P and Q apparatus with large capacity to earth or to other parts of the circuits, and other diagrams in the specification describe how this difficulty may be overcome.—*December 7th, 1922.*

169,691. September 2nd, 1921.—IMPROVEMENTS IN HIGH-FREQUENCY TELEGRAPH AND TELEPHONY, Gesellschaft für Drahtlose Telegraphie, m.b.H., of 9, Tempelhofer Ufer, Berlin, Germany, and Dr. Hermann Gewecke, of Nowawes, Germany.

In high-frequency telegraph and telephone systems employing heavy current lines it has been proposed, in order to prevent the reflection which may occur on lines in which high-frequency waves are flowing, to insert in the line ohmic resistances of the

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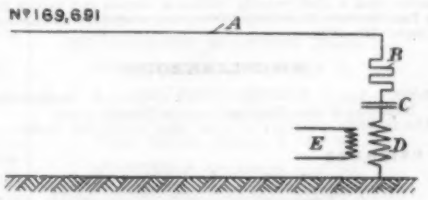


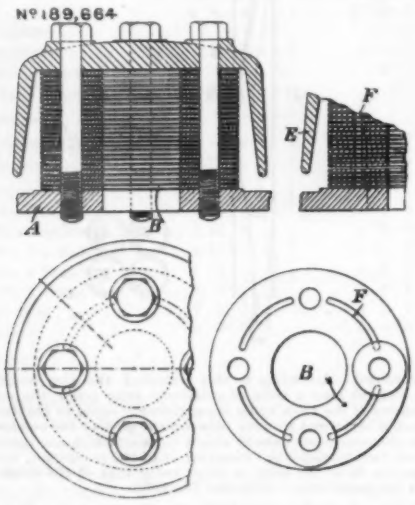
values of the high-frequency resistance of the line, and, in order that these resistances may not disturb the passage of the low-frequency currents, to bridge these resistances by choke coils which possess for the low frequency a low impedance, but for the high frequency a high impedance. According to this invention an ohmic resistance equal to the high-frequency resistance is inserted, not in the line, but in parallel with it. In order that the resistance may not form a short circuit for the high tension there is inserted in series with it a condenser designed to block

the high tension and an inductance, the natural frequency of the condenser and inductance being equal to that of the high-frequency waves to which they therefore offer a very small impedance. This inductance can also be used for coupling the high-frequency apparatus. The above described combination may be arranged, instead of between two high-tension lines, between a line and earth. The invention is illustrated by the accompanying drawing, in which A is the high-frequency line, which is connected through an ohmic resistance B, a condenser C, and an inductance D to earth. The coil D may be coupled inductively by the coil E to the high-frequency apparatus.—*December 4th*, 1922.

SWITCHGEAR.

189,664. December 15th, 1921.—IMPROVEMENTS IN SAFETY VENTS FOR ELECTRIC MOTOR CASES, SWITCH BOXES, JUNCTION BOXES, AND THE LIKE, The Electrical Construction Company, Limited, of Dashwood House, 9, New Broad-street, London, E.C. 2, and Bushbury Works, Wolverhampton, Stafford; and Frederick William Close, of the same address.

In the event of an explosion occurring inside the casing A the gases pass out through the vent in the centre and into the central vertical chamber formed by the superimposed holes B in metal plates, and then pass through the spaces between the plates, there being in effect four passages between each pair of plates, bounded laterally by the edges of washers. During the passage of the gases from the centre chamber to the slots F heat is imparted to the plates and the gases are considerably cooled,

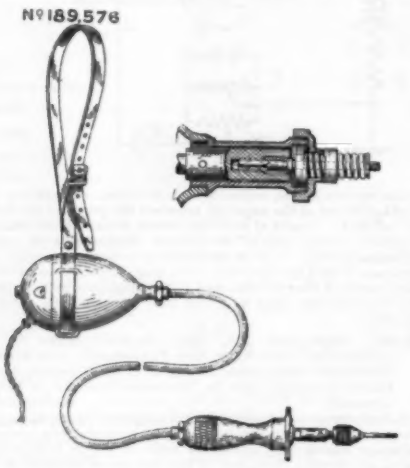


and on entering the vertical chambers formed by the slots F they are expanded and consequently further cooled. On leaving the slots F the gases are rapidly cooled by expansion due to the increasing cross-sectional area of the passages and by the fact that they impart considerable heat to the plates. Thus, when the gases arrive at the inside of the bell E they have parted with such a quantity of heat that there is no danger of their setting fire to any explosive material that may be in the vicinity.—*December 7th*, 1922.

MACHINE TOOLS AND SHOP APPLIANCES.

189,576. September 14th, 1921.—IMPROVEMENTS IN OR RELATING TO PORTABLE ELECTRICALLY DRIVEN COMBINATION TOOLS, Frederic Pooley, Francis Clifford Austin, and William Leonard Wreford, all of 34, Broadway, Westminster.

The motor which drives the tool, such as a drill, is contained in an egg-shaped casing which is provided with a harness or belt

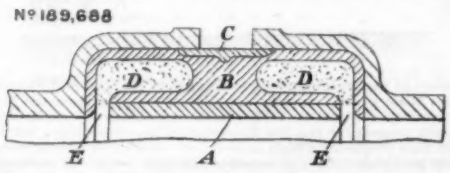


so that the motor may be attached to the operator. A handle member and a shaft rotably mounted therein and driven from the flexible shaft is arranged to operate various attachments.—*December 7th*, 1922.

MISCELLANEOUS.

189,688. August 31st, 1921.—PIPE JOINTS, J. Hetherington, Malwood House, Malwood-road, S.W. 12.

The inventor proposes to make pipe joints, and similar connections, tight by means of hollow rubber rings packed inside with a material such as spongy rubber, gelatine, or a mixture of either with cork, that will be expanded by the fluid pressure in the pipe. In the figure two socketed pipes are connected together with an intervening ferrule A. The rubber ring B is reinforced at C and is packed with the expansible material D. The fluid pressure has access to this material through the openings E E.—*November 30th*, 1922.



Catalogues.

BATTERIES, Limited, Redditch.—List No. 4, describing the Nife lamp.

UNITED STEEL COMPANIES, Limited, The Ickles, Sheffield.—A list of the firm's products.

G. AND T. EARLE, Limited, Hull.—A copy of this firm's monthly magazine, *The Pelican*.

JOHN JARDINE, Limited, Deering-street, Nottingham.—Sheet No. 70, dealing with stalk hangers.

RUSTON AND HORNSBY, Limited, Lincoln.—Catalogue of the "Ruston" cold starting oil engine.

O. N. BECK, 11, Queen Victoria-street, E.C. 4.—A leaflet on the Universal electric boiler scaler.

CADBURY BROS., Bournville, Birmingham.—Pamphlet 4/22, treating with health in the factory.

BROOM AND WADE, Limited, High Wycombe.—A model card discussing the firm's patented air compressors.

C. E. LUGARD AND CO., Ashover, near Chesterfield.—Descriptive pamphlet concerning the new Vulcan drive.

CLEWORTH, WHEAL AND CO., Limited, Castleton, Lancs.—A new pamphlet entitled "The Natural Humidifier."

THE ENGLISH ELECTRIC COMPANY, Limited, Queen's House, Kingsway, W.C. 2.—Publication No. 368, dealing with "Cable Spans."

WARDLE ENGINEERING COMPANY, Limited, Old Trafford, Manchester.—Catalogue No. 15: Lanterns, Reflectors and Fittings.

THE SKEFKO BALL BEARING COMPANY, Limited, Luton, Beds.—An abridged catalogue, pocket edition, of S.K.F. ball and roller bearings.

CRANE PACKING COMPANY, 1800, Cuyler-avenue, Chicago.—Illustrated pamphlet setting forth the manufactures of the company.

BUTLER MACHINE TOOL COMPANY, Limited, Victoria Ironworks, Halifax.—Catalogue No. 2 of traverse head shaping machines.

IGRANIC ELECTRIC COMPANY, Limited, 147, Queen Victoria-street, E.C. 4.—Leaflet No. 180, describing Igranic ironclad motor starting panels.

HICK, HARGREAVES AND CO., Limited, Bolton.—A pamphlet on the firm's new patented "closed feed system for the deaeration of boiler feed water."

SAXONIA ELECTRICAL WIRE COMPANY, Limited, Roan Works, Greenwich, S.E. 10.—A copy of a general catalogue of Saxonia flexible wires, cables, cords, &c.

CENTURY WOOD PRESERVING COMPANY, Century Building, Pittsburg, Pa.—Bulletin No. 24, concerned with "Treated Ties and Timbers for Industrial Plant."

THE BRITISH TIMKEN COMPANY, Limited, Ward End, Birmingham.—A copy of Journal 209.

ROWNSON, DREW AND CLYDESDALE, Limited, 225, Upper Thames-street, E.C. 4.—A folder which describes elevators and conveyors for different purposes.

ENGINEERING AND LIGHTING EQUIPMENT COMPANY, Limited, Sphere Works, St. Albans, Herts.—Leaflet describing the "Anti-break" electric lamp economiser.

BARIMAR, Limited, 10, Poland-street, Oxford-street, W. 1.—An illustrated booklet giving records of repair work carried out by the Barimar process of welding.

HOLLINGS AND GUEST, Limited, Thimble Mill-lane, Birmingham.—Illustrated list No. A106, dealing with hydraulic scrap metal bundling presses; also list No. A101, devoted to hydraulic and screw presses for fixing rubber tires on motor vehicle wheels.

SIEMENS BROTHERS AND CO., Limited, London.—Catalogue containing information concerning telephones and accessories; also dealing with fire alarm systems, power plant for telephone exchanges, vacuum arresters, central battery telephone exchanges, and automatic telephone exchanges for public and private use.

GENERAL ELECTRIC COMPANY, Limited, Magnet House, Kingsway, W.C. 2.—A copy of revised prices of low and medium-tension switchgear; also catalogue Section P7, second edition, concerned with electric lighting sets; also leaflet X2858, giving alterations in prices of circuit breakers; also pamphlet giving particulars of electric lifting magnets.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

THE JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, S.W. 1. Paper, "Transient Phenomena Arising in Transformers from Switching Operations," by Mr. S. A. Stigant. 7.30 p.m.

INSTITUTION OF AERONAUTICAL ENGINEERS.—The Engineers' Club, Coventry-street, W. 1. Discussion, "Gliding" and "Gliders at Itford." 6.30 p.m.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS.—Engineers' Club, Coventry-street, W. 1. Lecture, "Automatic Temperature Control," by Mr. B. R. Wingfield. 7 p.m.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS Literary and Philosophical Society, Newcastle-upon-Tyne. "Review of Different Types of Marine Internal Combustion Engines." 7.30 p.m.

SATURDAY, JANUARY 13TH.

INSTITUTION OF BRITISH FOUNDRYMEN: LANCASHIRE BRANCH.—Grand Hotel, Manchester. Smoking concert. 6 p.m.

KEIGHLEY ASSOCIATION OF ENGINEERS.—Queen's Hotel, Keighley. Annual dinner. 5.45 p.m.

INSTITUTION OF BRITISH FOUNDRYMEN: LANCASHIRE BRANCH.—Grand Hotel, Manchester. Paper, "The Evolution of the Foundryman," by Mr. W. H. Sherburn. 4 p.m.

INSTITUTE OF MARINE ENGINEERS.—85-88, The Minories, Tower-hill, E. 1. Juniors' social concert and dance. Members invited. 6.30 p.m.

MONDAY, JANUARY 15TH.

INSTITUTION OF CIVIL ENGINEERS: NEWCASTLE-UPON-TYNE ASSOCIATION.—Neville Hall, Newcastle-upon-Tyne. Paper, "The Reconstruction of the South Dock Entrance Gates at Seaham Harbour," by Mr. J. W. Goldson. 7.30 p.m.

THE INSTITUTION OF AUTOMOBILE ENGINEERS: SCOTTISH CENTRE.—Royal Technical College, Glasgow. Paper, "The Technique of Calculation," by Mr. James Watt. 7.30 p.m.

TUESDAY, JANUARY 16TH.

INSTITUTE OF TRANSPORT.—Institution of Electrical Engineers, Savoy-place, Victoria Embankment, W.C. 2. Graduates' and students' meeting. Lecture, "The Employment of Transport in relation to Post Office Operations." 5.30 p.m.

MANCHESTER GEOLOGICAL AND MINING SOCIETY.—Queen's Chambers, 5, John Dalton-street, Manchester. Paper, "Wave Power Transmission," by Mr. W. Dinwoodie. 3 p.m.

INSTITUTION OF CIVIL ENGINEERS.—Great George-street, Westminster, S.W. 1. Continued discussion on "Twelve Years' Operation of Electric Traction on the London, Brighton and South Coast Railway." 6 p.m.

INSTITUTE OF METALS: NORTH-EAST COAST LOCAL SECTION.—Armstrong College, Newcastle-on-Tyne. Paper: "Plastic Flow in Metals," by Professor C. H. Desch. 7.30 p.m.

WEDNESDAY, JANUARY 17TH.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, W.C. 2. "Hygienic Methods in Painting: The Damp Rubbing-down Process," by Mr. C. A. Klein. 8 p.m.

THE INSTITUTION OF AUTOMOBILE ENGINEERS: WOLVERHAMPTON CENTRE.—Victoria Hotel, Wolverhampton. Paper, "A New System of Carburation," by Mr. W. A. Whatmough. 7.30 p.m.

THE INSTITUTION OF AUTOMOBILE ENGINEERS: BIRMINGHAM GRADUATES.—Chamber of Commerce, New-street, Birmingham. Paper, "Liquid and Gaseous Fuels for Automobiles," by Mr. J. F. Berry. 7.30 p.m.

ROYAL METEOROLOGICAL SOCIETY.—49, Cromwell-road, South Kensington, S.W. 7. General meeting. 7.30 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Visit of the London Graduates to the repair works of the London General Omnibus Company, Limited, Chiswick. Meet outside the works, opposite Gunnersbury Station (District Railway). 3 p.m.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS: GRADUATE SECTION.—Neville Hall, Newcastle-upon-Tyne. Paper, "Some Principles of Design in Reinforced Concrete Structures," by Mr. E. J. Rang. 7.15 p.m.

INSTITUTION OF CIVIL ENGINEERS.—Great George-street, Westminster, S.W. 1. Students' meeting. Vernon Harcourt Lecture on "Foundations in Dock and Harbour Works," by Mr. T. R. Wilton. 6 p.m.

THURSDAY, JANUARY 18TH.

ROYAL AERONAUTICAL SOCIETY.—Royal Society of Arts, John-street, Adelphi, W.C. 2. Lecture, "Flying Boats," by Major J. D. Rennie. 5.30 p.m.

INSTITUTION OF MECHANICAL ENGINEERS: NORTH-WESTERN BRANCH.—Memorial Hall, Manchester. Paper on "Machine Tools for Locomotives," by Mr. C. D. Andrew. 7 p.m.

LIVERPOOL ENGINEERING SOCIETY: STUDENTS' SECTION.—Royal Institution, Colquitt-street, Liverpool. Paper, "The Steam Extraction Engine," by Mr. E. Cockshutt.

INSTITUTION OF AUTOMOBILE ENGINEERS.—28, Victoria-street, S.W. 1. London graduates' meeting. Paper, "Valve Operating Mechanisms," by Mr. E. Chatterton. 8 p.m.

NORTHAMPTON ENGINEERING COLLEGE ENGINEERING SOCIETY.—St. John-street, E.C. 1. Paper, "The Gyro-compass," by Mr. J. W. Perkins. 5.30 p.m.

INSTITUTION OF MINING AND METALLURGY.—The Geological Society, Burlington House, Piccadilly, W. 1. Paper—"Note on an Apparatus for Small-scale Flotation Tests," by Messrs. H. L. Sulman and H. F. K. Picard. 5.30 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS.—Savoy-place, Victoria Embankment, W.C. 2. "Works Production," by Mr. G. H. Nelson. 6 p.m.

FRIDAY, JANUARY 19TH.

FINSBURY TECHNICAL COLLEGE OLD STUDENTS' ASSOCIATION.—The Engineers' Club, Coventry-street, W. 1. Smoking concert. 8 p.m.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, S.W. 1. Symposium of papers on "Indicators." 6 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—Albemarle-street, Piccadilly, W. 1. Discourse, "Soap Films as Detectors: Stream Lines; Vortex Motion and Sound," by Sir James Dewar. 9 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, S.W. 1. Lecturette, "Laminated Springs," by Mr. T. H. Sanders. 7.30 p.m.

MONDAY, JANUARY 22ND.

INSTITUTION OF MECHANICAL ENGINEERS: GRADUATES' SECTION.—Storey's-gate, S.W. 1. Informal discussion, "The Value of College Training to Engineers." 7 p.m.

TUESDAY, JANUARY 23RD.

INSTITUTE OF MARINE ENGINEERS.—85-88, The Minories, Tower-hill, E. 1. Film illustrating works of W. Beardmore, Limited. 6.30 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Chamber of Commerce, New-street, Birmingham. Paper, "The Technique of Calculation," by Mr. James Watt. 7.30 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Broadgate Café, Coventry. Meeting of Coventry Graduates. Paper, "Piston Rings," by Mr. G. H. Day. 7.45 p.m.

WEDNESDAY, JANUARY 24TH.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Visit of the Birmingham graduates to the works of the Gear Grinding Company, Limited, Handsworth. Meet outside the works. 2.45 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS: NORTH OF ENGLAND CENTRE.—Education Offices, Salford. Paper, "Railless Trolley Traction," by Mr. C. W. J. Taffs. 7.30 p.m.

THURSDAY, JANUARY 25TH.

LIVERPOOL ENGINEERING SOCIETY.—Midland Adelphi Hotel, Liverpool. Annual dinner. 7 p.m.

THE INSTITUTION OF STRUCTURAL ENGINEERS.—Denison House, 296, Vauxhall Bridge-road, S.W. 1. Paper, "The Relations between the Architect and the Engineer," by Mr. W. J. H. Leverton. 7.30 p.m.

MONDAY, JANUARY 29TH.

INSTITUTION OF AUTOMOBILE ENGINEERS.—The College, Loughborough. Meeting of Loughborough graduates. Paper, "Some Notes on Current Motor Cycle Design," by Mr. A. K. Harvey. 7 p.m.